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TO ADVERTISERS

CHANGES for advertisements should be in this office by Friday noon for the following week's issue.
NEW ADVERTISEMENTS should be in the office not later than Monday noon to insure publication in that week's issue.

It has been announced that Mr. J. B. McDonald, the contractor for the Rapid Transit Commission's subway, now under construction in New York, is using every effort to finish a portion of the work in time to conduct an extensive series of trials of various methods of traction in it before deciding upon what system shall be adopted for the entire work. This is an eminently reasonable and sensible thing to do, and electrical engineers are to be congratulated upon the opportunity provided by Mr. McDonald for the preliminary determination of the factors which will enter into the somewhat complicated problem of tunnel road operation. Of course, it goes without saying that an electrical system of some sort will be adopted.

THE GANZ SYSTEM OF ELECTRIC TRACTION.

On other pages of this issue will be found the first complete description of an installation for electric traction on the Ganz high-tension polyphase system that has yet appeared in the United States. In describing the lines of the Valtellina region of Italy, Signor Bignami has gone into considerable detail of the power-house, line and car equipment of this most interesting and extraordinary railway. The well-known ability and prominence of the author make the article all the more interesting.

Perhaps the ease and simplicity and the inexpensiveness of the equipment there described will answer some of the numerous and not always over-intelligent criticisms which American engineers have been making of polyphase systems for electric traction. It has been contended in these columns often and over that the alternating current would eventually find a large place in railway operation. Indeed, it has seemed evident that the greatest step in the direction of electrical equipment of main-line railways would be taken when the merits for alternating current for this class of work were fully recognized and systems using it were worked out on a large scale. While we may naturally feel some degree of regret that the first important installation of this character was made abroad, yet we may very profitably study the admirable work of our colleagues in Italy and Hungary who have laid down this fine plant, with a view to adopting some of the ideas embodied in their work—and possibly also of improving upon it.

The main lines of the system, as indicated in Signor Bignami's article, are the employment of a very high initial tension directly generated at low frequency upon the dynamos, and its distribution to a number of transformer substations situated along the line of the railway. At these stations there is an entire absence of moving machinery. Their maintenance and operation costs are practically nothing and, although the capital cost is somewhat high, yet it is nowhere nearly so high as it would be were it necessary to include rotary converters and switchboards in each substation. From these distributing points three-phase current, at a working pressure of 3,000 volts in each phase, is fed directly to the trolley wires, two in number, the track forming the third conductor. The system of car wiring is such that this high-tension current enters only the primary windings of the motors where it is amply protected, and the current that is handled in controllers and rheostats is of the very moderate tension of 300 volts. It will be observed that there are no transformer apparatus upon the cars and that the elements of the induction motors employed themselves constitute transformers both for voltage and frequency. The method of connecting polyphase induction motors in cascade has been suggested before, we believe, by Mr. Steinmetz, but so far it seems to have met little recognition in this country, and not to have been worked out as fully as might be expected. The solution which Messrs. Ganz & Company have made of the difficult problem imposed upon them by the operating conditions on these lines is one that appeals directly to the American idea in engineering. They have obtained their results in the simplest and most direct fashion without recourse to the usual complexity of apparatus which marks European installations, and apparently without particular reference to non-essential details. It seems somewhat doubtful if a very high efficiency, electrically speaking, can be had by this system, but there can be little doubt that the cars will be effectually and promptly moved and make their schedule time over one of the most difficult railroads in the world.

There are so many opportunities in the United States for the application of this

sort of railway system that it is some wonder that no similar installation has been attempted here. We can not be said, in general, to be afraid of high voltages, because high-voltage work has been carried to its greatest extreme in this country. We have developed and perfected the induction motor to a high point and there seems no reason why our engineers and our manufacturers can not produce an alternating-current system of high availability and prepared to give excellent service. With the numerous interurban lines of great length which are now operated in this country and the many projected electric railroads of a reasonably heavy-service character, we have an abundant opportunity for working out the alternating-current traction system in its completest detail. It is to be hoped that this opportunity will not long remain unused and that advantage will be taken of the conditions surrounding this branch of the industry to perfect a method of operation which must eventually greatly increase the field of electric traction and open the way to the electrical conquest of the steam railroad.

THE FOURTH AVENUE TUNNEL PROBLEM.

The Grand Jury of the County of New York handed in last week to the Court of General Sessions a presentment covering the conditions obtaining in the railway tunnel under Fourth avenue in New York city. It was declared by the Grand Jury, whose report was voluminous and exceedingly comprehensive, that the tunnel is a public nuisance on account of the accumulation of vitiated air and gases from locomotives in it. Strong recommendations were made for improvements to be undertaken, the chief of which was the adoption of electric traction for the tunnel service. The report says:

"From evidence adduced before it, the Grand Jury is convinced that in the present state of the art of electric application to mechanical ends the progress has been so general and uniform that everything requisite for an electrical installation in the tunnel and its approaches is as standard at the present time as steel rails or car wheels; that to install electrical traction in these tunnels and the approaches thereto everything required can be had without difficulty, delay, or great initial expense."

The conditions of operation in this tunnel are remarkable. It was built thirty years ago at a time when the demands made upon it were far less than they are to-day. The tunnel consists, really, of three parallel tunnels occupying nearly the entire width of the street, the central tunnel carrying two tracks and being open at intervals into the street above. The side tunnels have small openings on the sides toward the central tunnel into the latter, and each of these carries one track. In all 530 trains per day traverse the tunnel, each being hauled by a steam locomotive. The total length of the tunnel and its approaches is about two miles, and the time required to traverse it, when trains are not blocked in the tunnel, is from three and one-half to five minutes. In the report of the Grand Jury there is much detail concerning the amount of air consumed by a locomotive in going through the tunnel and the amount of gases given off, as well as of the vitiation of the air in passenger coaches due to the breathing of the occupants. It states that each locomotive leaves in the tunnel about 80,000 cubic feet of steam and gases—equal to the amount that would be vitiated in the same time by the breathing of 87,000 human beings. Temperatures in the cars passing through the tunnels often exceed 100 degrees Fahrenheit and the atmosphere of the cars becomes so foul that passengers have been observed to lose consciousness or become ill during the tunnel transit.

The statement of the Grand Jury, that the art of electric traction is now advanced to such a point that electrical equipment for this service is perfectly practical and comparatively easy, is entirely true. The tunnel presents no problem whatever that several companies manufacturing traction apparatus are not ready and willing to solve. It is not unlikely that the introduction of electricity for train operation in the tunnel would cause a decided difference in the method of train operation and it is scarcely to be expected that methods based upon the employment of locomotives would be continued when that method of traction is superseded by another. It seems fair to say, without venturing any criticism upon the officers of the railway companies using this approach to New York city, that a diligent investigation of the conditions and of the capacity of electric traction to handle the traffic, would bring to light the fact that a vast enhancement of their suburban passenger business could be secured by a change in the motive power.

New York city has been treated to an object lesson in the operation of electric tramways by the efficient and admirable management of the Metropolitan Street Railway Company. There is no part of the lines of this corporation in New York city that is more pleasant to traverse, either in the hot weather of summer or the cold days of winter, than the old tunnel in Fourth avenue through which its cars run for several blocks. This tunnel is whitewashed inside, is well lighted and maintains a fairly equable temperature the year round. Exactly the same conditions might be easily attained in the tunnels north of the Grand Central station were electric traction to be adopted.

A consideration of the utmost importance, both to the railway companies and the public, is the fact that New York city's natural growth is to the north. Here, within a moderate distance of the centre of business activity in the city, is high, well-drained and very beautiful country, admirably situated for suburban homes and capable of an immense development. So long, however, as access to this region must be had by traversing a railway tunnel loaded with combustion gases in closed cars vitiated by the breathing of many people natural development is retarded and property values remain comparatively low. It is believed that the taxable valuation of that part of Greater New York comprised within the County of Westchester, would be enhanced by figures that would astound statisticians, provided this improvement were carried out. It is to be hoped, therefore, that the agitation now going on, of which the Grand Jury presentment is only one phase, will soon convince these railway managements of the necessity as well as of the advisability of making the change and eliminating the locomotive from the confines of New York city.

THE INSTITUTE'S SUMMER MEETING.

From present appearances it is believed that the summer meeting of the American Institute of Electrical Engineers, which begins in New York city, August 14, and ends at Buffalo, August 25, will be one of the best attended and most interesting in the history of the Institute. The presence of a number of foreign visitors will add particular interest to this occasion and the unusual attractiveness of the programme will doubtless secure a large attendance.

The idea of traveling in a body to visit great centres of manufacture and points of electrical interest is an exceedingly attractive one. The trip up the Hudson River is one of the most beautiful in the United States, if not in the world, and everybody who goes on this occasion will be certain to have at least a pleasant time. It is quite as certain that members and guests attending the meeting will also be profited by the discussions which will take place and by the papers which will be presented. The programme of the meeting was published in full in the last issue of the ELECTRICAL REVIEW.

It is exceedingly pleasant for the Institute to have this opportunity to reciprocate the many attentions shown it by French electrical engineers last summer. The party which is now on the way from Paris will comprise a number of the most eminent electricians of Europe and their presence at the Institute meeting will add no little to the interest and value of the occasion. Every member should make an earnest effort to be present at the meeting and take part in the excursion to Buffalo and Niagara Falls, or if this is impossible at least to be present at the dinner next Thursday night where an unusual feast of good things, both material and intellectual, will be set forth.

This summer has witnessed a very great extension of electric lighting facilities in all parts of the United States. An increasing number of small towns have been supplied with stations and in general the central station business has expanded in all parts of the country. The gas companies at the same time are making an excellent showing on account of the rapidly increasing use of gas for cooking and heating purposes. Notwithstanding the introduction of Welsbach burners in many places it is believed that gas is making no substantial gains as an illuminant, but it will always have a field as a fuel, being probably the best fuel for domestic purposes that has ever been devised. Electric light is more and more taking its place as the usual and standard illuminant in the United States. It is to be regretted that we have not taken more kindly to the eight-candle-power lamp in this country. In a great many situations lamps of this size would give all the light that is needed, and would so materially reduce the bills of consumers as to put electric lighting to the front as the cheapest as well as the best illuminant possible for them to obtain.

One point which has not been referred to in the agitation concerning the New York Central Railroad's tunnel in New York city, is the admirable management which has permitted the safe handling of 530 trains a day in the tunnel and terminal yards at the Grand Central Station. When this tunnel and terminus were built—now more than twenty-seven years ago—it was not foreseen that the traffic would ever grow to such enormous proportions as it has to-day. Consequently some of the most difficult problems that have ever been imposed upon a railway management have been met and solved in connection with the continued operation of this terminal hampered as it is by restricted space and an ever-increasing number of trains. In all the years of its operation only four passengers have been killed in the tunnel. This extraordinary record should not be overlooked by those who are accusing the railway management of dilatory progress in perfecting the tunnel system. Electricity will undoubtedly solve the dilemma in which the railway company finds itself, but perhaps it is well that progress has been made slowly, for now there can be no doubt of the outcome of any experiment on electrical installation. Once introduced, the electrical system will make the tunnel a pleasant section of the road to traverse either in summer or winter, and permit the highest speeds with safety.

ELECTROCHEMISTRY.

In this week's issue of the ELECTRICAL REVIEW is presented the fourth chapter of Professor H. C. Jones's admirable series of articles on electrochemistry. These valuable papers deal with a subject which is not only of fascinating interest but of the most enormous potential value. In probably no other direction is electrical application making more rapid strides than in the use of electric current as a means in chemical work. The presentation of this series, which is the first of a popular character to be published, will doubtless stimulate the interest and attract the attention of many to whom electrochemical work is at present an ill-understood subject. Professor Jones has the happy faculty of uniting with a clear and luminous presentation of his subject an unusually attractive literary style, which makes these articles as interesting as they are important.

With the continual increase of asphalt and other impervious pavements the problem of gas leakage in our larger cities is becoming more and more important. With pipes buried a short distance below the surface and exposed to very wide ranges of temperature it is practically impossible to maintain tight joints. The leakages of gas from buried pipes reach figures which are absolutely astonishing. Fair practice shows an average leakage of nearly a quarter of a million cubic feet per year from a mile of six-inch main. This gas has to go somewhere, and in its passage through the soil, being robbed of many of the tarry and less volatile compounds which give ordinary illuminating gas its odor, the hydrogen, carbonic oxide and other inflammable elements escape practically without odor, thus giving no warning of their presence. How many mysterious fires and explosions have been due to this cause no one knows, but their number is certainly large and at the same time it is likely that the public health is none the better for the constant vitiation of the air of houses by these gases. The question is one which deserves to be taken up and very fully studied by municipal authorities, and is certainly one that demands the closest attention from engineers to make the dangers incident to it as small as possible.

Science Brevities

Static Electricity in the Treatment of Sprains—Dr. Leonard C. Stanford describes this treatment in the *Boston Medical and Surgical Journal*: The electricity is generated from a large Holtz machine. The patient is placed on an insulated platform, which is connected with the negative pole of the machine by a brass rod. An electrode, connected with the positive pole by a brass chain, gives off the spark after the circuit has been completed; the length of the spark is from two to four inches. The application is made over and around the painful areas by the positive electrode. It lasts from 10 to 15 minutes, occasionally broken by a short intermission. For sprains with little or no effusion this treatment is very satisfactory. When effusion is present there seems to be little effect besides relief of the pain. Injuries of long standing are not generally so favorably influenced as those of the acute variety. Care in the administration of this treatment should be exercised, as occasionally an unpleasant reaction follows.

Low Temperature Electrical Effects—Professor Dewar, in a recent Bakerian lecture, said: The great increase of phosphorescence in the case of organic bodies cooled to the boiling point of hydrogen under light stimulation is very marked, when compared with the same effects brought about by the use of liquid air. A body like sulphide of zinc cooled to 21 degrees absolute and exposed to light shows brilliant phosphorescence on the temperature being allowed to rise. Bodies like radium that exhibit self-luminosity in the dark, cooled in liquid hydrogen maintain their luminosity unimpaired. Photographic action is still active, although it is reduced to about half the intensity it bears at the temperature of liquid air. Some crystals, when placed in liquid hydrogen, become for a time self-luminous on account of the high electric stimulation brought about by the cooling, causing actual electric discharges between the crystal molecules. This is very marked with some platino-cyanides and nitrate of uranium. Even cooling such crystals to the temperature of liquid air is sufficient to develop marked electrical and luminous effects. Considering that both liquid hydrogen and air are highly insulating liquids, the fact of electric discharges taking place under such conditions proves that the electrical potential generated by the cooling must be very high. When the cooled crystal is taken out of either liquid and allowed to increase in temperature, the luminosity and electric discharges take place again during the return to the normal temperature. A crystal of nitrate of uranium gets so highly charged electrically that, although its density is 2.8 and that of liquid air about 1, it refuses to sink, sticking to the side of the vacuum vessel and requiring a marked pull on a silk thread, to which it is attached, to displace it. Such a crystal rapidly removes cloudiness from liquid air by attracting suspended particles to its surface. The study of pyro-electricity at low temperatures will solve some very important problems.

Bismuth Estimated Electrolytically—The current number of the *Journal* of the Chemical Society contains an abstract of a paper by Herr Karl Wimmenauer on this subject. The author has examined the methods for the electrolytic estimation of bismuth and gives details of his results. an accurate and expeditious estimation is best obtained as follows: The electrolyte should contain 0.1 gramme of bismuth oxide to 1 to 0.5 cubic centimetre of concentrated nitric acid, and if an excess of nitric acid is not employed, two to four cubic centimetres of glycerol (one part glycerol to two parts water) must be added, and the solution diluted to 150 cubic centimetres. When this solution is subjected to electrolysis, using a current of 0.1 ampere at first, and reducing this to 0.05 ampere as soon as any indication of peroxide is detected, a dense, bright deposit is obtained, which is easily washed without loss. It is essential that the electrolyte should be continuously agitated during the deposition. Quantities up to 0.4 gramme of bismuth are easily deposited in three hours. The temperature of the solution is gradually raised to 50 degrees and maintained at this until all the bismuth is deposited. The results are within 0.1 to 0.25 per cent of the theoretical.

A New Element; "Europium" — M. Demarçay, in the course of his spectrum analysis work, claims to have discovered a new element to which he proposes to give the name of *Europium*. In the account which he has recently presented to the Académie des Sciences, M. Demarçay brought out the following points, says the *Scientific American:* Sir William Crookes, while pursuing his vacuum tube researches, observed, in 1885, a band which he attributed to samarium and which, on account of its disappearance in the presence of lime, and other peculiarities, he called the *anomalous ray*. Later on he distinguished it, together with a great number of other bands, each of which appeared to characterize a special meta-element. He called S δ the hypothetical metal-element which corresponded to the *anomalous ray*. In 1892 De Boisbaudran described a series of three brilliant blue lines, which he discovered in the spectrum of the samarium spark. These lines could be brought out more strongly by a fractional treatment of the material and he concluded that they were due to a special element, which he called Z ζ. In 1896 M. Demarçay announced the presence of an element intermediate between gadolinium and samarium, which was characterized by several strong violet and ultra-violet rays. He also showed that the new element was identical with that of De Boisbaudran, and no doubt accounted for the anomalous band of Crookes, as well as other rays not yet described. At that period M. Demarçay could not obtain enough of the material to make further experiments, but at present he has accumulated a larger quantity of it by a fractional treatment of nitrate of magnesium, and finds that its characteristics, namely, line and absorption spectra, electric fluorescence of the sulphate in vacuo, etc., accompany it constantly and are proportional, thus evidently belonging to one and the same element. The purity of the few grammes of the new oxide obtained was sufficiently great to exclude all the samarium rays, and only the stronger gadolinium rays were visible in the electric spectrum. If the product was added in traces to sulphate of calcium, it gave a brilliant spectrum of fluorescence in which the *anomalous ray* predominated. This spectrum includes three principal bands, $\lambda = 609$, very strong; $\lambda = 576$, considerable and wide; $\lambda = 593$, strong and very wide (the figures are approximate). The degree of calcination of the sulphate caused variations in the bands; the strongest seems to change to a double ray when the calcination is strong. The author proposes the name *europium* for the new element, with the symbol eu = 151 (about). He then gives a list of 40 of the principal rays of its spectrum comprised between $\lambda = 500$ and $\lambda = 350$; the strongest of these are as follows: $\lambda = 4{,}662.6$; 4,627.8; 4,594.5; 4,435.8; 4,205.4; 4,130.0; 3,972.0; 3,930.7; 3,819.5, etc. In this spectrum the samarium rays were entirely absent and the strongest gadolinium rays were scarcely visible. Besides the rays given, which no doubt belong to *europium*, a great number of feeble rays are seen, which may belong to this element or perhaps to an unknown element even more rare; this the author proposes to study later.

THE THEORY OF ALTERNATING DYNAMO ELECTRIC MECHANISMS—XXXVIII.

BY W. ELWELL GOLDSBOROUGH.

In the development of the discussion of polyphase systems we have thus far made use of two typical diagrams, namely, those of Fig. 88 and Fig. 89. In connection with these, the discussion has been confined to the consideration of two-phase working, and the electro-motive forces developed by the elements acting have been considered as having a phase displacement relatively to one another of 90 degrees. By further modification of the connections shown in Fig. 98, we will introduce a third generating element, namely, E^{II} of Fig. 104. By the introduction of E^{II}, the relation of the circuit A_2O to the circuits A_1O and A_3O is materially changed.

With the three alternators, E^{I}, E^{II} and E^{III}, all working synchronously, we have a multiphase system before us of considerable complexity, a solution of which we must effect by a general application of the same rules as have been already employed. Fig. 104, since it includes three electro-motive forces acting upon interlinked circuits, represents a three-phase system. Regarded as individual circuits, there is no one of them that can be strictly considered as returning upon itself. The extent of the first circuit is $O'A_1O$; of the second circuit, $O'A_2O$, and of the third circuit, $O'A_3O$; consequently we see that there is an intimate interdependence of the circuits one upon the other, and that, as a whole, they form a system, the properties of which are interesting.

If the constants of each of the circuits are known, as well as the electro-motive forces developed by the three alternators, a determination of the exact conditions which obtained in each of the three circuits can only be arrived at by following out the principle of considering each of the generators as acting separately. Later, after the effects produced by each of the three acting individually have been found, resultants can be taken, which will show

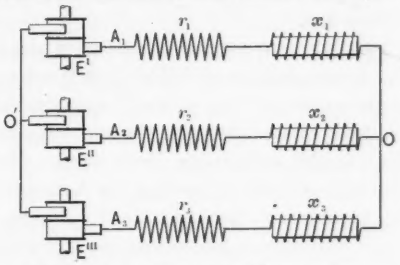


FIG. 104—ALTERNATING MECHANISMS.

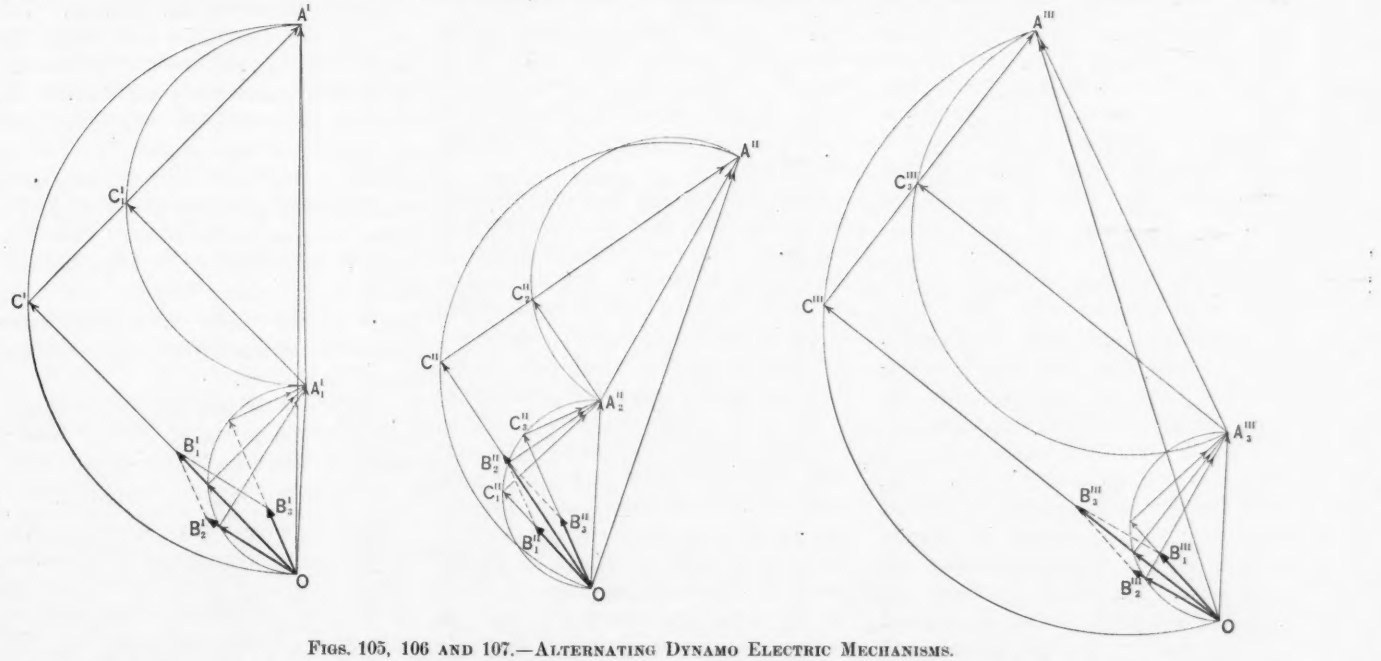
the exact values of the final electro-motive forces and currents which flow in each individual circuit. As a first step in such a determination we will consider alternator E^{I} to be acting alone, and that alternators E^{II} and E^{III} are temporarily "dead." Under these conditions we will have a system consisting of the circuit O_1A in series with a parallel system consisting of A_2O and A_3O.

In the second instance, if we assume that alternator E^{II} is acting alone and the other two machines "dead," we will have a system composed of the circuit A_2O in series with a parallel system composed of the circuits OA_1 and OA_3; and, lastly, when alternator E^{III} is acting alone, a system consisting of A_3O in series with a parallel system OA_1 and OA_2.

For present purposes, it will be sufficient to assume that the values of r_1, r_2 and r_3, and of x_1, x_2 and x_3 are the same as those which obtain in the discussion of Fig. 98. This being true, we have the conditions which exist when E^{I} and E^{III} are active already accounted for, since their evaluation was made in connection with the discussion of Fig. 98. These results are reproduced in Figs. 105 and 107.

In Fig. 105, OA_1^{I} represents an electro-motive force which it is assumed is impressed upon the parallel circuits OA_2 and OA_3 at the terminals O'O. Accordingly, OB_2^{I} and OB_3^{I} are the branch currents set up in OA_2 and OA_3, and OB_1^{I} the resulting current flowing in the circuit OA_1. To force this current through the circuit OA_1 an electro-motive $A_1^{I}A^{I}$ is needed; therefore, to produce the current values given, the alternator E^{I} would have to develop an electro-motive force equal to the resultant of the vectors OA_1^{I} and $A_1^{I}A^{I}$, or an electro-motive force equal to OA^{I}.

In the case of Fig. 107, an electro-motive force OA^{III} is assumed as impressed at the terminals O'O, and to be acting upon the parallel system OA_1 and OA_2; accordingly, the currents OB_1^{III} and OB_2^{III} are set up in these branch circuits, and their resultant OB_3^{III} is the current to be forced through the circuit OA_3. To accomplish this will require an electro-motive force equal to $A_3^{III}A^{III}$; consequently, when an electro-motive force equal to OA_3^{III} is maintained at the terminals O'O, alternator E^{III} must develop an electro-motive force OA^{III}, since this is the resultant of the vectors OA_3^{III} and $A_3^{III}A^{III}$.



FIGS. 105, 106 AND 107.—ALTERNATING DYNAMO ELECTRIC MECHANISMS.

Selected Chapters in Electrochemistry.

By Harry C. Jones.

CHAPTER IV—ELECTROLYSIS AND THEORIES OF ELECTROLYSIS.

PART I.

THERE are few subjects in electrochemistry which have attracted more attention than the power of the current to decompose chemical compounds. This action has been known almost as long as the current itself. It was impossible to study these phenomena when the only source of electricity was that produced by friction, since a continuous supply could not be obtained for any appreciable length of time. Almost as soon as Volta discovered the pile which bears his name, these phenomena began to attract attention; but the first who made an extensive study of the power of the current to decompose chemical compounds was Sir Humphrey Davy. As is well known, he constructed the most powerful electrical battery which had been devised up to that time, and with this he was able to effect decompositions which had never been suspected as possible. His classical experiments, in which he decomposed potassium and sodium hydroxides, and discovered the alkali metals, are so well known that they need only a brief reference in this connection. Portions of his battery, and his notebooks in which these and other important discoveries are recorded, are still preserved at the Royal Institution, London, in connection with which much of his work was done.

THE WORK OF FARADAY.

There is, however, still one greater name in connection with the subject of electrolysis, and that is Faraday. For a considerable time Davy's assistant, and later his successor at the Royal Institution, Faraday continued the work which Davy had begun, and made discoveries of incomparably greater value. While Davy's work was mainly qualitative, testing what decompositions the current could effect, the work of Faraday was quantitative. He wished to know how much of given substances are decomposed by given amounts of the current, and whether the amount of decomposition was always proportional to the amount of current used, regardless of the source of the current. He tested the latter point in this manner: Currents of electricity produced in different ways were passed through solutions of the same substance, and the amount of decomposition determined. He found that a given amount of current always produces the same amount of decomposition, no matter what the source of the current may be. He then used different amounts of current and studied the amounts of decomposition effected. *The amount of decomposition was always proportional to the amount of current used.* This may be termed the first law of Faraday.

Faraday went much farther and studied the decomposition of different substances by the same current, to see if any simple relations existed between the amounts of the different substances decomposed. He accomplished this by passing the same current through solutions of salts of a number of the metals, and determined the amounts of metals which were deposited. The result was the discovery of his well-known second law, that *the amounts of the different metals deposited by the same current are proportional to the chemical equivalents of these metals.* If we are dealing with the salts of univalent metals, the amounts deposited are proportional to the atomic weights of these elements; if we are dealing with bivalent elements the amounts deposited are proportional to the atomic weights of the elements divided by two; if with trivalent elements, to the atomic weights divided by three; if with n-valent elements, to the atomic weights divided by n.

These two laws are the most important discoveries which have ever been made in connection with electrolysis, and both of them we owe to Faraday, who also gave us the *electrochemical nomenclature,* which we use up to the present time. He termed the parts in solution, which move as the current is passed, *ions;* those which move in the solution with the current, *cations,* and those which move opposite to the current, *anions.* The substance which, in solution, undergoes decomposition by the current he called an electrolyte, and the process by which these substances are decomposed *electrolysis.* The places at which the decomposition manifested itself he termed the *poles* or *electrodes;* that pole toward which the cations move he called the *cathode,* that towards which the anions move, the *anode.*

Faraday distinguished sharply between two classes of conductors: Those which carry the current without undergoing decomposition, such as the metals, carbon, etc., which he termed conductors of the *first class;* and those which undergo decomposition at the electrodes, such as solutions of acids, bases, and salts. These he termed conductors of the second class.

That there is a sharp distinction between the two classes of conductors, seems to be doubtful at present. Recent work has made it probable that the metals conduct by means of ions, as solutions of electrolytes conduct by means of ions; the difference in the results obtained being, in part, due to the different conditions which surround the ions in the metal and in the solution.

TESTING THE LAW OF FARADAY.

There are few laws in nature which have been subjected to more rigid experimental test than the law of Faraday. Conditions have been varied wherever it was possible, to see whether the law would hold. It appeared a few years ago as if exceptions had been discovered to the law. If a current is passed through solutions of certain electrolytes, which are subjected to a high pressure, there is slightly less decomposition effected by a given quantity of current than if the solution of the electrolyte is under normal pressure. This was not explained for a time, other than as an exception to the law of Faraday. A perfectly satisfactory explanation has, however, been furnished. When the liquid is subjected to high pressure, more of the air above it is forced into solution, and a small part of the oxygen, or nitrogen, or both, is ionized by the solvent. These ions help to carry the current from one electrode to the other, with the result that more current passes than would correspond to the amount of metal separated upon the cathode.

The law of Faraday has, then, withstood all tests, and is one of the few laws of nature to which no exceptions are known.

ELECTROCHEMICAL THEORIES.

The discovery that chemical compounds can be decomposed by the current seemed to make it probable that there was a very close connection between chemical attraction and electrical attraction. This idea was further strengthened by the fact that in the voltaic cell we have chemical action going on, and an electric current produced. Chemical action and electrical action thus seemed, in a sense, to be complementary. When an electric current was passed through a solution containing certain chemical compounds, these compounds were broken down; the chemical attraction which held them together being overcome. Conversely, in the cell we have chemical compounds being formed,

and at the same time a current was generated.

These relations were thought by Davy to be very close, as we shall see from the theory which he proposed to account for chemical union. According to the *Electrochemical Theory of Davy* the atoms of different substances exist in an uncharged condition; but when they come in contact they become charged—the one positively and the other negatively. These positively and negatively charged atoms attract one another just as any other positively and negatively charged bodies would do; the force of the attraction for a given distance depending upon the magnitude of the difference between the charges. The electrolysis of a compound, in terms of the electrochemical theory of Davy, consists in the separation at the poles of the different elements in an uncharged condition. The negatively charged atom is attracted to the positive pole, and, having its potential raised to zero by addition of positive electricity, separates on this pole in a neutral condition. Similarly, the positively charged particle is attracted to the negative pole, and through addition of negative electricity becomes electrically neutral and separates from the solution in this condition.

The electrochemical theory of Davy never came into prominence, and never seems to have exerted any marked influence on chemical thought. Shortly after it was proposed it was entirely overshadowed by another electrochemical theory; *viz.*, that of Berzelius.

THE ELECTROCHEMICAL THEORY OF BERZELIUS.

The electrochemical theory of Berzelius differs fundamentally from that of Davy, in that it assumes that the *atoms are charged before they come in contact.* The natural condition of the atom is to be charged, and, indeed, both positively and negatively. These opposite charges exist upon the atom in polar arrangement, but either the positive or negative charge predominates in magnitude, so that the algebraic sum of the charges upon any atom is always either a positive or a negative quantity, and never zero. Every atom acts, then, as if it were charged either positively or negatively.

Chemical attraction is nothing but the electrical attraction of these oppositely charged atoms; the magnitude of the attraction depending upon the difference between the charges upon the atoms which enter into the compound. When the differently charged atoms come in contact the electrical differences would disappear, and then the atoms would fall asunder, since the attraction which held them together no longer exists. This seems to be a weak point in the electrochemical theory of Berzelius. However, as quickly as the atoms parted company, the electrical differences would be reestablished, and they would again attract one another, and we would have a continual decomposition and recombination taking place.

Another objection was urged against the electrochemical theory of Berzelius, which led to its abandonment for more than half a century. If chemical attraction is nothing but the electrical attraction of oppositely charged parts, then the properties of the compound formed must be a function of the electrical charges upon the atoms. If any two compounds resembled one another closely in properties, the electrical charges upon the atoms must be closely analogous. It was found that the two compounds, acetic acid and trichloracetic acid, are closely allied in their chemical and physical properties. In the latter we have three atoms of chlorine corresponding to three atoms of hydrogen in the former, as can be seen at once by comparing their formulas:

Acetic Acid.	Trichloracetic Acid.
CH_3COOH.	CCl_3COOH.

It was reasoned that the hydrogen atoms in acetic acid, like the hydrogen atoms under all other conditions, are charged positively; and the chlorine atoms which have replaced them, like all other chlorine atoms, are charged negatively. We have thus, replaced three positive charges in acetic acid by three negative charges, and have not materially changed the nature of the compound. This argument was too much for Berzelius, and in spite of many attempts was never answered satisfactorily by him. The result was that his theory fell into disrepute, and was simply rgarded as a convenient means of classifying substances, without in any wise being a correct expression of the facts.

THOMSON OVERTHROWS THE OBJECTIONS TO THE ELECTROCHEMICAL THEORY OF BERZELIUS.

This objection to the Berzelius theory, which passed muster for considerably more than half a century, has recently been entirely overthrown by the work of J. J. Thomson.* He took a glass tube, closed at both ends, and sealed platinum electrodes into the two ends. A sheet of aluminum was placed across the middle of the tube, but did not fit tightly against the glass walls; the tube was filled with vapors of chloroform, which is methane in which three of the hydrogen atoms have been replaced by chlorine. This will be seen from the formulas of the two substances:

Methane.	Chloroform.
CH_4.	CCl_3H.

If marsh gas is electrolyzed by passing the current between the electrodes, the hydrogen, like other positively charged substances, would move toward the *negative* pole. We would suppose that the chlorine in chloroform, being negatively charged, would pass to the positive pole; but Thomson found that *it also went to the negative pole.* This showed that *the chlorine in chloroform was not negatively charged, as had been supposed, but was positively charged.*

The importance of this discovery can not easily be overestimated. It shows, conclusively, that the same atom may, under different conditions, have entirely different charges upon it, since we know that chlorine is usually negative. It shows, further, that *atoms of positive hydrogen are replaced by atoms of positive chlorine.* This throws entirely new light on the whole nature of substitution in chemistry, making it probable that atoms carrying one kind of electricity are only replaced by atoms carrying a charge of the same nature; *i.e.*, positive atoms by positive, and negative atoms by negative.

The bearing upon the argument against the electrochemical theory of Berzelius is at once obvious. The *three positive hydrogen atoms* in acetic acid are replaced by *three positive chlorine atoms,* and the nature of the two compounds should from the theory, as they are in fact, be very closely allied.

We recognize to-day that the electrochemical theory of Berzelius contains a large element of truth, and is one of the forerunners of the theory of electrolytic dissociation.

OLDER THEORIES TO ACCOUNT FOR ELECTROLYSIS.

Almost as quickly as the facts connected with electrolysis became known attempts were made to account for these facts in terms of conceptions which then prevailed. This is the usual course of procedure. The thinking mind is never content with the discovery of isolated facts, nor even of facts which bear some vague relations to one another. It wants to know what deep-seated relation really exists between the facts; it desires to correlate the facts and see if possible what they really mean. "The aim of research," says a distinguished man of science, "is not the discovery of facts, but the discovery of generalizations," and the

*For a detailed account of Thomson's experiment, see *Nature*, 52, 453. Also Theory of Electrolytic Dissociation, Jones, p. 42.

more one thinks over this proposition the more one sees the deep meaning which it contains. Facts, and theory or generalization bear about the same relation to each other as the bricks and a magnificent piece of architecture. The bricks are absolutely essential to the structure, but they, in themselves, are not the aim of the architect. The aim of science is to discover these great truths of nature which we call generalizations, and the facts are the essentials out of which the edifice of truth is built.

The first to propose *a theory of electrolysis was Grotthuss,** in 1805. This theory is now only of interest historically, yet, for the sake of the development of our subject, it must be considered. The facts which had to be accounted for at that time were comparatively few. It was known that when a little acid is added to water to make it conducting, as they said, and a current is passed, hydrogen was liberated at the cathode and oxygen at the anode. This was explained by Grotthuss as follows: Let us think of a layer of water molecules between the anode and the cathode. Starting at the cathode we would have a hydrogen atom with a positive charge. This would give up its positive charge to the pole and escape as hydrogen gas. The oxygen atom, which was originally combined with this hydrogen, is now free and combines with the hydrogen atom of the next molecule of water. This sets free another oxygen atom, which combines with the next hydrogen, and so on until the anode is reached, when the last free oxygen atom gives up its charge to this pole and escapes as oxygen gas.

The feature of this theory which distinguishes it from subsequent theories, is that in water every hydrogen atom is firmly and fixedly combined with a definite oxygen atom, and never parts company with it until the current is passed.

The above theory accounted for all the facts which were known at the time it was proposed, but it was soon discovered that a current which is far too weak to decompose a molecule of water would still effect the electrolysis of acidified water. This could not be accounted for at all by the theory of Grotthuss, and led to a *new electrochemical theory, that of Clausius.* The theory of Clausius, which was proposed in 1856, has already been referred to in connection with the development of the theory of electrolytic dissociation. The distinctive feature of the theory of Clausius, as we have seen, is that it assumes that before the current is passed a small number of water molecules are already broken down into parts or ions. This would account for the fact just referred to, that an infinitesimal current, which is far too weak to decompose a molecule of water, can effect the electrolysis of water. The action of such a current is simply a directing one, driving the anions toward the anode and the cations toward the cathode, where they lose their charges and separate in the uncharged condition. We have already seen that the theory of Clausius is the immediate forerunner of the theory of electrolytic dissociation, and we shall see a little later in this paper, is connected quite closely with the theory of electrolysis which we hold to-day. We shall now take up the newer theories of electrolysis.

* See Theory of Electrolytic Dissociation, p. 46.

Electric Railroad Development in New York State.

The following paragraphs are taken from the account of electric railroad lines building and proposed in New York state, which the State Railroad Commissioners have given out:

The trolley roads are creeping up the valley of the Hudson River toward Albany, and already there is an electric road from Albany to Hudson. Between Albany and Pittsfield, Mass., there will soon be a trolley line. Albany is already connected with Lake George by trolley, and westward of Albany the trolley lines are creeping in fast between it and Buffalo. The new Albany & Schenectady line is nearly finished. Schenectady and Amsterdam will soon be connected. Fonda and Amsterdam are also to be connected by trolley, and tracks are now being laid between the two places. Utica, with its suburban roads, within a few months, it is said, will have a trolley line extending as far eastward as Little Falls. A line goes northwestward from Utica as far as Oriskany, and will soon reach Rome. An Oneida railroad company intends connecting Rome and Syracuse. Then comes a gap between Syracuse and Rochester, but recently there were filed articles of incorporation of the Monroe County Electric Belt Line, which intends to build an electric line from Rochester to Fairport, 10 miles on the road to Syracuse.

The big gap between Rochester and Buffalo is to be filled at once, the railroad commissioners having given consent to the Buffalo, Niagara Falls & Rochester Electric Railway to build a line 120 miles long, along the Ridge road, and connecting Lockport, Niagara Falls and Buffalo. Beyond Buffalo there are two lines to Hamburg, and it is reported that one of these lines will be extended to Angola and Silver Creek, while the Dunkirk line may be extended toward Buffalo.

Telephonic and Telegraphic Communication in England.

The following is an abstract from the interesting reply of the British Postmaster-General to the Association of Chambers of Commerce of the United Kingdom respecting the need of a more efficient telegraphic and telephonic service between the commercial and manufacturing centres of the United Kingdom:

"Every endeavor is made to keep pace with the growth of the traffic, which has been particularly rapid in the case of the telephone trunk service; and a large number of additional trunk circuits have been erected or are in course of construction. It has, however, not been practicable to make such progress as could be desired, owing partly to the difficulty experienced in many directions in obtaining the necessary way-leave facilities, and partly to the lack of an adequate supply of skilled labor. In many cases delay in telephonic communication arises from unavoidable interruptions of the trunk circuits from subscribers being engaged on other trunk calls, and from the inadequacy of the National Telephone Company's junction system. It is found, however, that delay due to these causes is frequently attributed by the public to the want of a sufficient number of trunk wires. The association may perhaps be interested to learn that in addition to the system containing about 29,000 miles of wire purchased from the National Telephone Company, about 47,831 miles of wire had been erected by the post office up to the end of March last, making a total to that date of 76,831 miles. The number of trunk circuits which have been authorized year by year from March, 1896, to March, 1901, is as follows: For the year 1896-1897, 83; 1897-1898, 65; 1898-1899, 74; 1899-1900, 93; 1900-1901, 125; and a large number of additional circuits will be authorized during the present financial year. Additional telegraph wires are being erected wherever they are needed, and in addition the Postmaster-General is endeavoring especially to insure greater stability in the telegraph service by the provision of reserve wires for the purpose of bridging over interruptions by storm or other causes, and by the extension of the underground telegraph line which was brought into use between London and Birmingham last year, and has been found of great assistance in securing safe and steady working."

An electric automobile has recently run in England 94¾ miles on one charge. The total weight was 39 hundredweight, and the weight of the battery was 22 hundredweight. Four persons were carried at an average speed of 12 miles per hour.

Heavy Electric Traction in the North of Italy.

The First Installation of the Ganz System of Polyphase Traction—Electrical Equipment of the Valtellina Lines of Upper Lombardy—Sixty-seven Miles of Main Line Electric Railway, with 3,000 Volts on the Trolley Wires.

By Enrico Bignami.

A GREAT WORK, which is attracting the attention not only of Italians, but of all those interested in the field of electric traction and those who see in the application of electricity to railway lines the solution of no small number of problems, is already near its accomplishment.

If the trials which will be made in a few weeks from now upon the railway system of the Valtellina fulfill, as we have every right to think they will, the anticipations of their projectors, the lines from Lecco to Colico, from Colico to Sondrio, and from Colico to Chiavenna will open in the autumn a regular service for passengers and freight under the conditions more particularly set forth below.

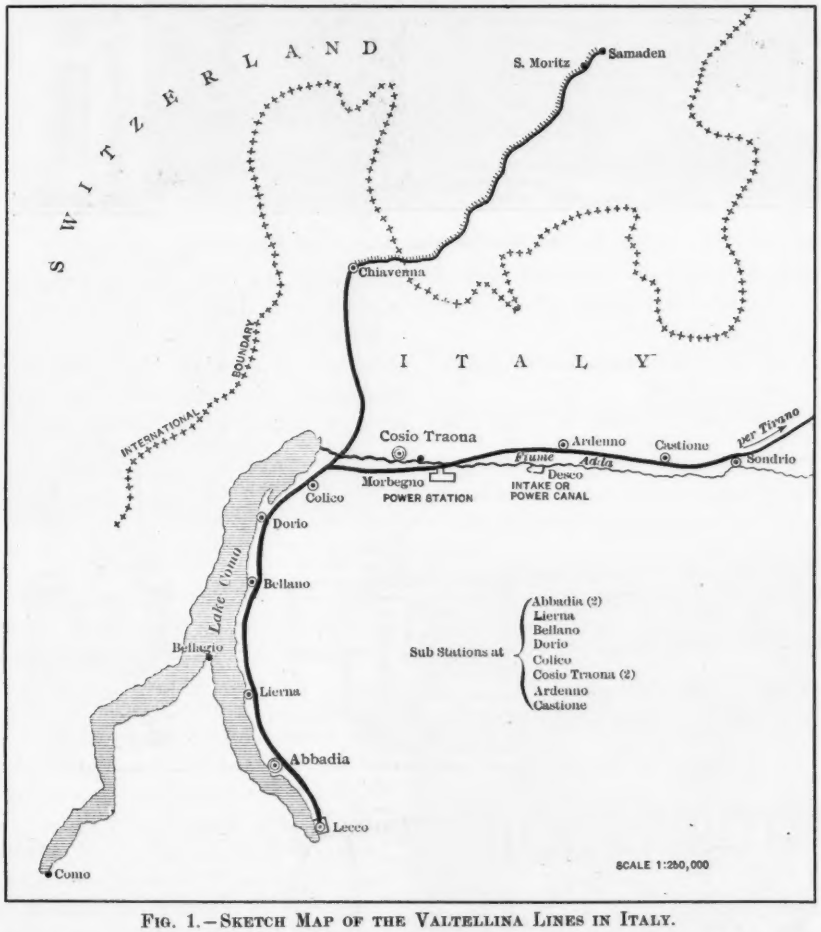


FIG. 1.—SKETCH MAP OF THE VALTELLINA LINES IN ITALY.

Among the many projects undertaken by Italian railway companies that which has been put in shape by the Societa Italiana delle Ferrovie Meridionali, with a capital of 260,000,000 francs, and in cooperation with the house of Ganz & Company, of Budapest, for the application of electric traction to 67 miles of railways north of Lecco, has attracted the greatest attention from technical people and the general public. The undertaking has involved the solution of most difficult problems concerning railway operation and electrical application.

It should be said at the beginning that the company mentioned above has studied the electrical equipment and operation of railways particularly with a view to utilizing the water powers with which Italy is so rich, and with the hope of solving the problem of the economical operation of secondary railway lines—a problem of exceptional importance in Italy. It decided to equip, calling for the time this equipment an experiment, two of its lines having a considerable length and comprising upon their rights of way practically all the difficulties which could surround a new system. The trials which will be made are of two kinds. Each of the two systems answers particularly the conditions imposed by the regions in which the company's lines are operated. For lines comprising a considerable freight traffic and carrying numerous passengers the system of a central generating station with distribution of energy by a fixed conducting system has been adopted. For lines where the movement of freight as well as the number of passengers carried is smaller, but where the service can only be well taken care of by increasing the frequency of trains, a system of storage battery traction has been decided upon.

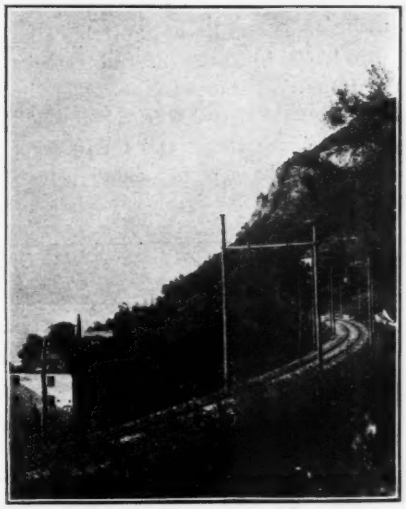


FIG. 2.—A SHARP CURVE ON THE LINE NEAR FIUMELATTE, ITALY.

The lines upon which the experiment in electric traction in question has been undertaken, as mentioned above, lie to the north of Lecco toward Sondrio and Chiavenna, and form a railway system almost independent of the rest of the company's lines and one upon which the conditions of traffic are somewhat singular. A map of the lines is shown in Fig. 1.

Serving the whole eastern side of the Lake of Como and the important centres, Chiavenna and Sondrio, whence depart

the railway lines for the Engadine, Berne and Haute Valtellina, passenger traffic on this line at certain times of the year, especially in the summer months, takes an extraordinarily important position. At these times 65 per cent of the total revenues is realized from passengers, while the annual average for Italian secondary railways shows only 35 per cent derived from this class of service. At these times of the year, having to carry principally tourists and numerous first-class travelers, this part of the service not only preponderates over the other, but its exigencies are such as to require a good train service of high speed with luxurious rolling stock and a costly baggage transportation service, which must necessarily be made upon the same trains on which the travelers journey. This in certain cases, which are really very numerous, naturally tends to make the train unit large.*

During the whole year, and particularly in summer, at the same time when through travel is so prominent a feature, a considerable local passenger movement is also noticeable on these lines. For this class of travel the frequency of train service and the question of expense have more interest than for the luxurious through travel mentioned above, and for its benefit the classes have been reduced to two, "first class" having been entirely suppressed, as the demand for it under the circumstances for short-trip travel is entirely insignificant. Since both in the Valtellina and through the region bordering on the Lake of Como there is a considerable movement of freight, it has been necessary in the organization of the electric service to plan for heavy trains given over entirely to freight traffic. The electric system has also to render a railway service of all classes which, at certain times of the year, has practically the same exigencies as that of a through traffic line. In order to attain this somewhat difficult end the service was organized upon the following basis:

1. The complete separation of freight and passenger traffic.

2. A radical distinction as to the composition of trains and their timetables between expresses, running between terminal points, and local trains.

3. The operation of trains of capacity sufficient for the expected needs of the traffic and the increase, during periods of exceptional travel, of the number rather than of the size of the trains.

The line contains grades up to a maximum of 22 per cent and curves of a minimum radius of 1,000 feet. One of these is shown in Fig. 2. There are no less than 32 tunnels, the most of these being in the first section between Lecco and Colico, a distance of 39 kilometres (25½ miles) in which no less than 27 tunnels are included. This section runs along the eastern side of the Lake of Como.

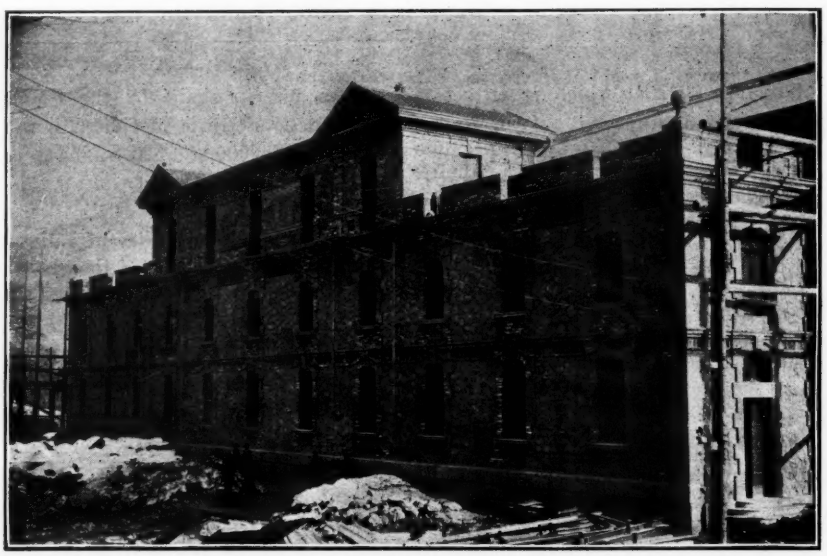


FIG. 4.—THE MAIN POWER STATION AT MORBEGNO.

Since, no matter what the train operation difficulties might be, it was necessary to serve the entire system by electric traction alone, the installation was designed so as to be able to take care of the simultaneous transportation of 750 tons of trains at any point where these might be gathered. This weight, according to the timetables adopted, may either be distributed between five passenger trains or two passenger and two freight trains.

Passenger trains consist of a motor car equipped with 300 horse-power of motors, capable of seating 60 passengers and carry-

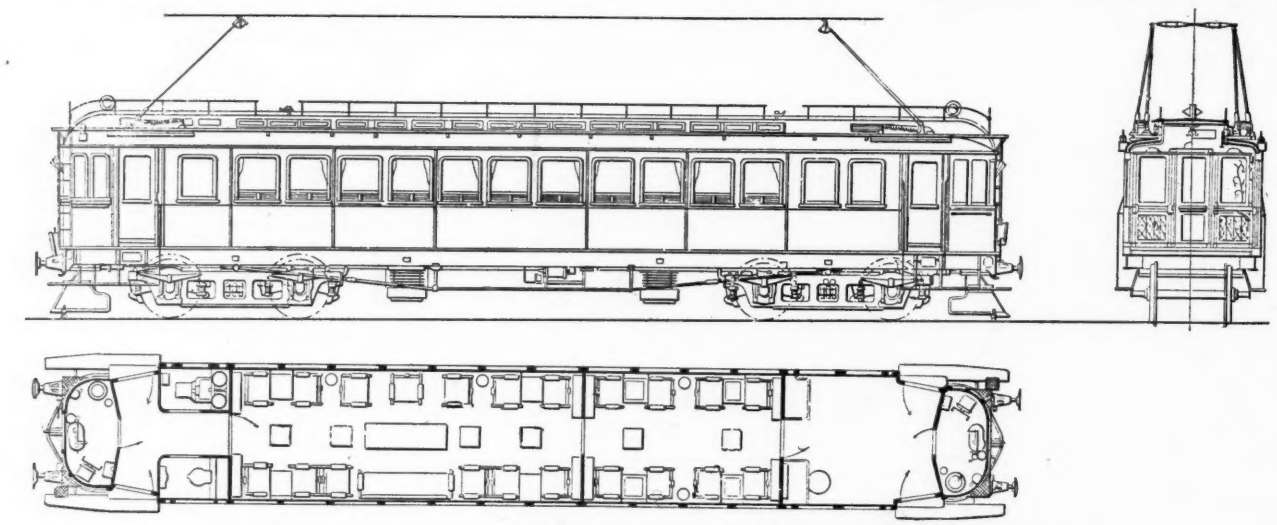


FIG. 3.—SIDE AND END ELEVATIONS AND PLAN OF MOTOR CARS FOR THE VALTELLINA LINES.

* [Signor Bignami evidently has in mind European railway service which, contrary to American practice, does not always provide baggage accommodations on passenger trains. There the baggage frequently follows the passenger at a more or less distant interval—EDS.]

ing in addition two tons of baggage, and of trail cars to the number of four of the ordinary Italian railway type. These are to operate at a speed of 60 kilometres (39 miles) per hour on grades up to 10 per cent. Fig. 3 shows the side and end elevations and the plan of this type of car. On grades greater than 10 per cent the speed is reduced to one-half the figure given above.

Freight trains are drawn by an electric locomotive of 600 horse-power, capable of handling a 250-ton train at a speed of 20 miles an hour on a 10 per cent grade.

These difficult conditions involve the solution of the problem of economical dis-

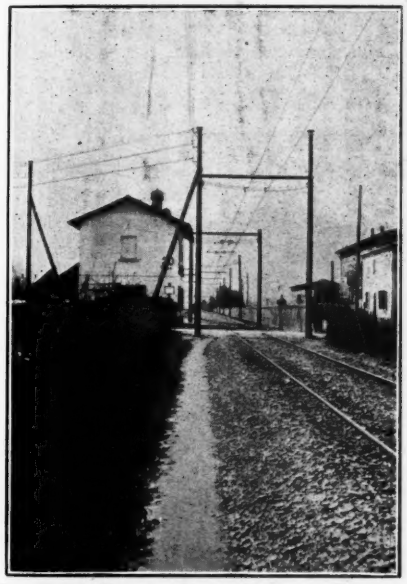


FIG. 5.—A TYPICAL PASSENGER AND FREIGHT STATION.

tribution at great distances of a considerable electrical power and its transmission to moving vehicles. It was decided that the solution lay in adopting three-phase current at high tension, both for the transmission line and for distribution to the motors themselves.

The work of installation and the furnishing of all the necessary material was undertaken by the Societa per la Trazione Elettrica sulle Ferrovie, of Rome, and the house of Ganz & Company, of Budapest. The latter concern furnished the turbine-wheels and all of the electrical material and machinery including the switchboards, except some generators built by the house of Schückert & Company, of Nürnberg, Germany.

All of the electric power for the three branches of the line is produced directly as three-phase current at 20,000 volts in the water-power station at Morbegno, shown in Fig. 4, situated about 10 miles from Colico. This is distributed by means of an overhead line of three conductors, having a diameter of eight millimetres each (0.32 inch), to 10 substations equally distributed along the line at a distance of 10 kilometres (6.2 miles) apart. These

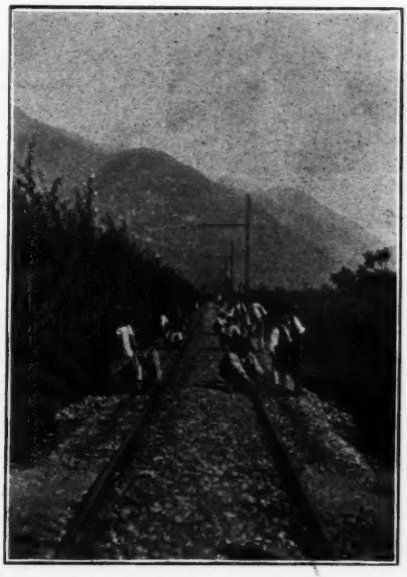


FIG. 6.—BONDING THE RAILS.

are well connected together by telegraph and telephone, these communication lines being also connected with the central station and the various passenger and freight stations. One of the latter is shown in Fig. 5.

These substations reduce the tension to 3,000 volts in each phase by means of transformers having a capacity of 450 kilowatts each. This current is distributed to the moving trains over two trolley wires,

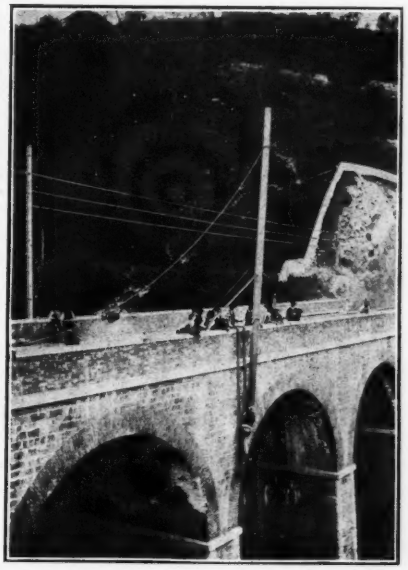


FIG. 8.—SETTING POLES ON THE CHIAVENNA BRIDGE.

each of eight millimetres diameter, the rails being used as the third conductor. The line is thoroughly bonded with copper bonds of the American type. On account of the use of a high potential the intensity of the current on the service line is limited to a comparatively small figure and on this account trolley wires of the small diameter of eight millimetres (0.32 inch) can be used. Even this size is larger than is required by considerations of electrical conductivity. The wire is of hard-drawn copper, not annealed, and to avoid the formation of points of weakness all the joints and the connections to the supporting ears instead of being soldered are made by cold pressure. Fig. 6 shows the process of drilling the rails for the insertion of the rail-bonds.

The trolley wires are suspended six

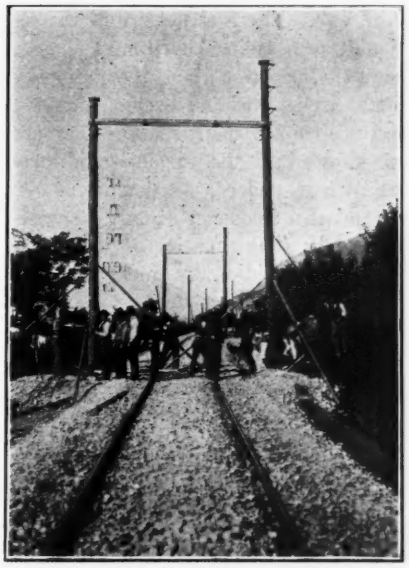


FIG. 7.—POLE WORK ON STRAIGHT TRACK.

metres (13 feet 2 inches) above the rails, although in the tunnels this height is reduced to 4.5 metres. The insulators, of the strain variety, are made of ambroine protected by a cast-iron shell, and are hung from cross wires of steel fixed to poles or to expansion bolts set in the rock of cuttings or masonry, porcelain strain insulators being included in the cross wire.

In the tunnels the insulators are carried by wrought-iron suspenders anchored in the tunnel vault. On the exposed lines wooden poles are used. Some interesting views of the pole work are shown in Figs. 7 and 8. All of the insulators were rigorously tested in a laboratory set up for the purpose at Lecco, a tension of 40,000 volts being used for this work. This, and much of the other testing and construction work, was done under the supervision of Signor P. Lanino, engineer of the railway company since the commencement of the work.

The necessary power for the operation of the entire system is 2,500 horse-power normal and 3,500 maximum at the power-

house, on the basis of a total efficiency of 65 per cent in the system and under maximum conditions of business on the line. Water power is developed at a point near the Morbegno station where, under a useful head of 30 metres (98 feet), a total flow of 422 cubic feet of water per minute is available. Fig. 9 shows the hydraulic developments at this point and the elaborate staircase of rock built to give access to the head-gates at the top of the two steel penstocks.

The interior of the station is shown in Fig. 10. The equipment consists of four units, each composed of a turbine-wheel and an alternator of 1,500 kilowatts, running at a mean speed of 150 revolutions per minute. The turbines are of the reaction type, having horizontal shafts, while the alternators are of the stationary armature type with an exciter mounted directly upon the main shaft. They are direct-coupled to the turbines and produce current under a tension of 20,000 volts and at a frequency of only 15 cycles per second. The capacity of these machines is 1,050 kilowatts under ordinary conditions and ranges up to 1,500 kilowatts for overloads. The turbines are governed by a Ganz regulator, consisting of an ordinary ball governor which manipulates a valve connecting a source of oil at high pressure with two pistons which operate the gates. The gates are of the cylinder type and the regulation secured is of great perfection and excellence. The oil is maintained under pressure in an accumulator by means of pumps connected with the turbines. All of the hydraulic works were designed and constructed by a young engineer, Signor Vittorio Gianfranchesi.

The primary line, on which the 20,000-volt pressure is maintained, is carried along the whole extent of the railway on porcelain insulators, of the triple petticoat variety and of a type slightly modified from that used in American practice. The same poles serve to carry the trolley line, but in tunnels, where difficulties with insulation might be expected, the primary line is carried around or over the obstruction to rejoin the trolley line at the further side.

The pole line is double, the poles being on each side of the track, as excellently shown in Figs. 7 and 8. The insulation of the service line is double; that is, the line is hung up by insulating bells in which ambroine is used as the insulating material, and these are in turn supported by short metallic cables attached to insulators of high quality. This type of construction is well shown in Figs. 11 and 12.

The lightning arresters at the central station, which are arranged in groups, are of the familiar "horn" type and are mounted on a metallic frame placed outside of the building. The lightning arresters at the substations are of the same type, but are mounted on the interior of the building while two similar arresters are placed on each of the motor cars. Wherever it is necessary to cross the high-tension line over the service line a system of guard wires is introduced, these being connected with the rails. At grade crossings, open to the public, a protecting system is applied which automatically opens circuits in wires that may fall to the earth. This is done either through the interposition of a fuse or an electro-mechanical circuit-breaker. Current is taken from the two trolley wires by means of two contact rollers of aluminum mounted upon the same insulated shaft. These rollers have an exterior diameter of 80 millimetres (a little over three inches) and at full speed of operation make 400 turns a second. The central cylindrical part of the roller is about 18 inches long and terminates at each end in truncated cones which are of particular advantage in passing switch points and crossings. A wooden rod carries these rollers, which are mounted on ball bearings, and in turn is carried itself on a wooden frame mounted upon a cast-iron base on top of the car. The current is taken from the roller by a brush running in contact with a graphite collar and passes down through a high-insulation cable, completely enclosed in a metallic pipe, directly to the stationary element of the induction motors used on the cars.

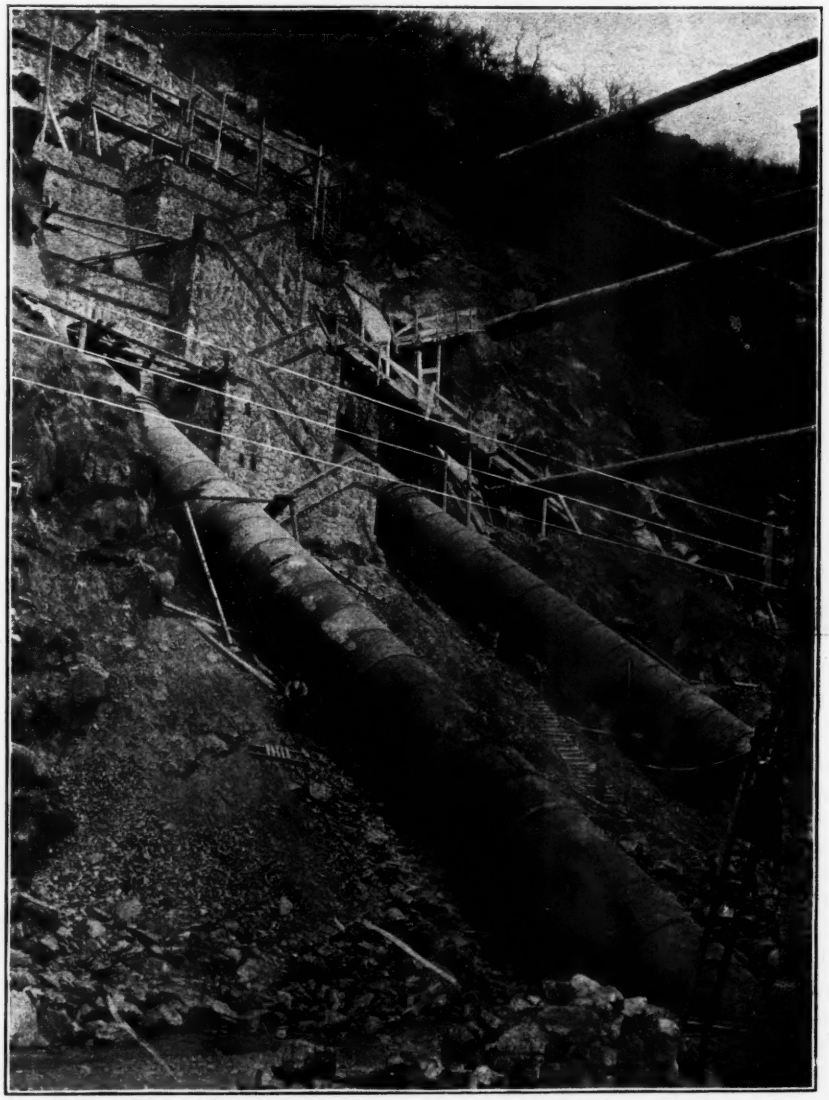


FIG. 9.—PENSTOCKS AND STAIRS TO HEAD-GATES AT THE MORBEGNO POWER-HOUSE.

To make the roller follow the sinuosities of the trolley wire and to adjust it in all positions there is a double system of springs which is operated from the motorman's compartment by compressed air, fed from

the air-brake pump. Compressed air being necessary for braking purposes it is also used to start the main motors, as will be shown below.

In order to simplify the electrical arrangements at switch points the conductors at stations are double and the trolley wires at stations are double, so that four wires are found over each line of rails. The two corresponding to the same phase are held two feet apart over the main line and are spread apart at diverging points, as is shown in Fig. 14. The actual crossing of the conductor of one phase and that of another is not attempted, wooden rods saturated with insulating material taking the place of the wires for 10 feet immediately at the crossing. The current supply is not interrupted, since each car carries a roller trolley at each end, the two being separated by a greater distance than the length of the break just referred to.

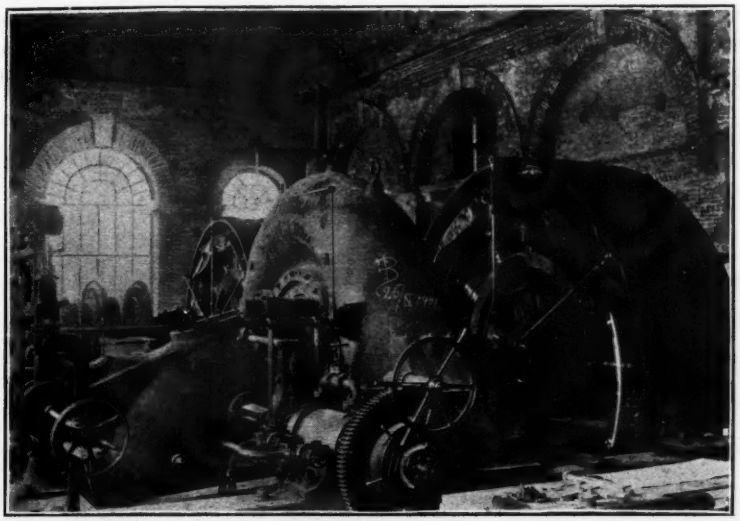


FIG. 10.—INTERIOR OF THE MORBEGNO STATION.

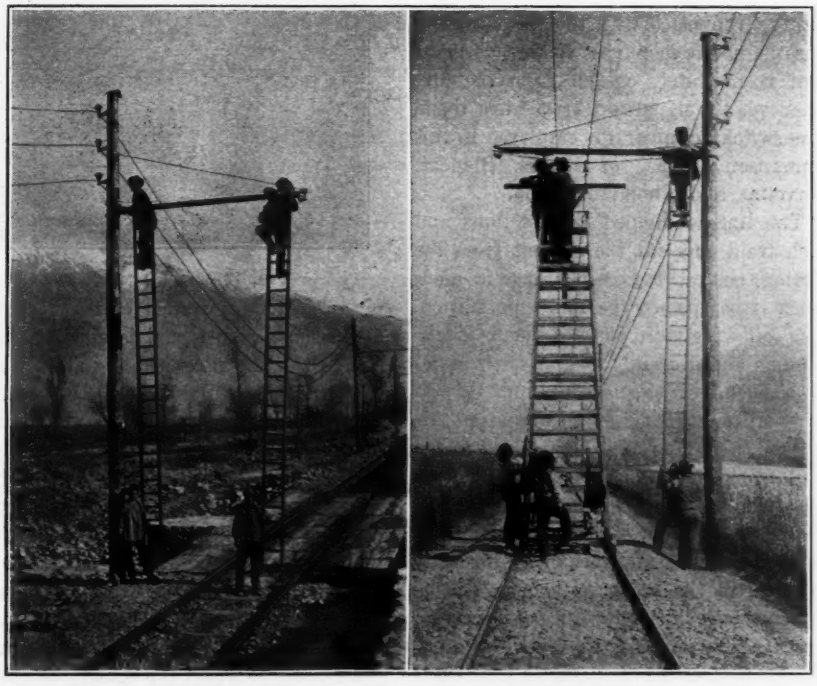
The 3,000-volt current from the trolley line is carried by heavily insulated cables, led in iron pipes which are in metallic connection with the rails, to the primary windings of the two induction motors mounted on each car. The secondary circuits of these motors are either led to liquid rheostats or to the primary windings of two other induction motors with which the car is provided. The motors are directly mounted on the car axles without gearing. The arbor of the motor is hollow and the axle passes through it, a flexible joint being provided at each end, allowing some play between the two and suppressing shock and vibration.

For starting and for slow speed, the two motors of each truck are coupled in tandem. This means that the primary of motor No. 1 is connected with the three-phase line and its secondary is connected with the primary of motor No. 2, in the secondary circuit of which is included a variable resistance. Under these conditions, at starting, current is generated in the moving element of the first motor and used to operate the second instead of being destroyed in resistances. This arrangement will accelerate rapidly up to an angular speed corresponding to one-half the frequency of the supply current. When this point is reached the second motor is cut out and resistance is introduced into the secondary circuit of motor No. 1 to correspond. This being cut out gradually, the motor works up to normal full speed. In this way the second motor replaces a large starting rheostat, with the important difference that it produces a useful torque available for rapid acceleration, while a rheostat is a source of pure loss.

In stopping, coupling the motors together in the starting position permits the system to operate as a dynamo and as a brake between normal speed and half-speed, and to save in this way some portion of the energy lost in starting. Really, by this method a portion of the kinetic energy of the train is restored to the line.

With the four motors coupled two and two in cascade, or tandem, the speed of the moving armatures is practically half of that of the rotating field of the primary motor, and half what it would be were the primary elements directly connected with the line. This gives two available running speeds, in this case of 60 and 30 kilometres (40 and 20 miles) per hour, while at the lower speed the traction effort of the motor car is twice as great as at the higher speed.

To avoid rapid starting and to regulate speeds, a liquid rheostat is used, this being an important accessory of the system. It consists of an iron case divided into three chambers, in each of which is contained a cylinder with four iron plates of different lengths, rounded at the bottom. These plates are coupled together alternately, current entering by one couple and leaving by the other. The rheostats are used in the secondary circuit, which has a tension of 300 volts only. The liquid contained in them is a solution of sodium carbonate, and instead of the plates mov-



FIGS. 11 AND 12.—HANGING INSULATORS ON POLE ARMS.

ing up and down in this solution the solution is made to move up and down in the cylinders in which the plates are contained by the action of compressed air. In starting, the plates are submerged one after the other, and thus vary the resistance of the rheostat, which depends on the final level of the liquid. Experiment has proven that by the use of this rheostat the torque can be kept practically constant during the period of acceleration.

This regulating apparatus, which is in connection only with the low-tension circuit from the secondary elements of the principal motors, is located in the compartment for the motorman, which contains also all the regulating apparatus necessary. This comprises the main switch, the starting switch, the controller for the secondary circuit, the switch for the air-brake pump motor and the valve for the operation of the trolley.

The insulation of induction motors being similar to that of transformers, and all of the parts in communication with the high-tension current being completely protected by a metallic shield which is in metallic communication with the rails, the greatest security to both passengers and apparatus is the result. Since the moving cars are fed by a single network of electrical distribution, in order to insure the absolute observance of line signals a system of switches and commutators appropriately connected with the switching apparatus has been put in so that the current is absolutely cut off from the cars whenever the signals are set against them. The switching apparatus employed in this connection is that of Messrs. Bianchi-Servettaz and Thompson-Webb.

The line is divided into sections and each train cuts out the current from the section behind it, establishing it anew when it has passed the following station. The following train can not then overtake the one ahead of it, for each train leaves always behind it one dead section.

Another element of security in this system is that no train can take its current from the overhead line without the Westinghouse air-brake apparatus is in good working order, since its operation depends on the maintenance of a proper air pressure in the brake reservoir. If this pressure falls the trolley can not be carried up into contact with the overhead wire. The whole method of operation thus lends itself to the effectual maintenance of a complete and efficacious block system, since no train can be moved into any section before its right of way is clearly signaled from ahead, nor can it move into any section where its signals do not permit it to go. Signaling apparatus allow the trolley current to pass only when it is proper to permit a train to go by a given station. At stations, since the conductors need to be alive only at the immediate time of the passage of a train, they are cut out normally, leaving the overhead system without current.

Each section of the line is controlled by an ingenious system of block signals and when a stop signal is given the circuit of the line is opened and at the same time the powerful brakes are applied to any train that may attempt to venture upon it.

As was stated above, this installation is almost complete. Three of the generating groups are installed and the fourth is in process of installation at the time of writing. Three machines that are at present in place are of the Schuckert type, running at 150 revolutions per minute.

In order to avoid the disastrous effects of a runaway, when the tension of the alternators might get to a dangerous point, there is mounted upon the shaft of each machine a centrifugal regulator which introduces a resistance into the field circuit whenever the speed passes 175 revolutions per minute. The machines can run up to 30,000 volts without danger of damaging the insulation in any way. To each of the generators is connected an ampere-meter, a synchronism indicator and a voltmeter. On the feeder lines going out of the station, which at present number three, are connected three ammeters, two wattmeters and a 100-ampere switch in each case. The motors are of course connected to the primary circuit through appropriate transformers. A direct-current machine of small size is mounted in the station for station lighting.

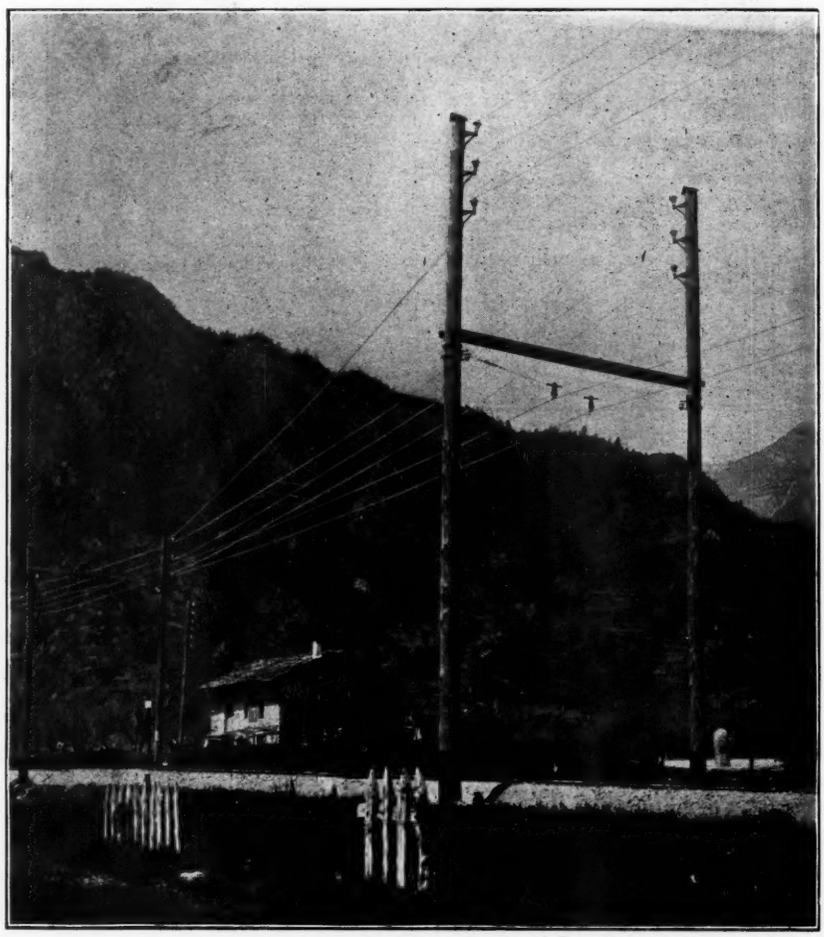


FIG. 13.—THE TRANSMISSION LINE CROSSING THE TRACK NEAR ARDENNO.

For the main power installation one machine will be held constantly in reserve. This will have a somewhat larger power than the other three, operating up to 1,800 kilowatts.

Several ingenious switches were furnished by Schückert & Company for the service line at 3,000 volts. These switches are made to break 100 amperes at that pressure. They are of the bipolar variety, the third pole being grounded in each case, and are made of two types, according to whether they are to be placed on cast-iron poles or on the tops of the ordinary wood-

en line poles. The switches are operated by means of a key through a transmission piece extending to a point about six feet above the ground and can only be worked by persons having the necessary key.

The first installation of rolling stock comprises five first-class motor cars, five motor cars for local trains, and two freight locomotives. The motor cars are 19 metres (62 feet) between buffers and weigh 54 tons each. The freight locomotives weigh 40 tons each. The four-wheel trucks of the motor cars are mounted 36 feet 6 inches apart.

Electric power is employed not only as motive power on these vehicles but also for lighting, ventilation and heating. All the lighting service of the stations is accomplished by current from the lines, but at a low frequency of 15 periods per second, the incandescent lamps flutter disagreeably and this inconvenience has been somewhat palliated by furnishing them with three filaments, one for each circuit, and using ground globes. It was thought that this arrangement would render the individual flutterings less visible, but the practical results have not been very encouraging and it is likely that storage battery lighting will be used throughout the system.

The entire system will be thrown open for public use during this month (August, 1901). At this time the Sondrio-Terrano branch will be completed and by means of another projected road will put the Valtellina in direct communication with the central and eastern portions of Switzerland.

Mountain Railroads in Colorado Contemplating the Use of Electricity.

Investigations are now in progress which may lead to a very important change from steam to the electrical operation of some of the existing railroads west of the Mississippi River. The only instances of changes of this character up to the present time have been east of the Alleghany Mountains. These have been principally upon certain branches of the New York, New Haven & Hartford Railroad, and on the Baltimore belt of the Baltimore & Ohio Railroad. The plan for equipping with electricity several of its lines from Denver to surrounding towns and also into the neighboring mountain cañons is now being considered seriously by the Colorado & Southern Railway. This railway is at present considering lines to Boulder, Golden, Clear Creek and Platte Cañon. Representatives of the engineering department have lately been studying the best systems of inter-

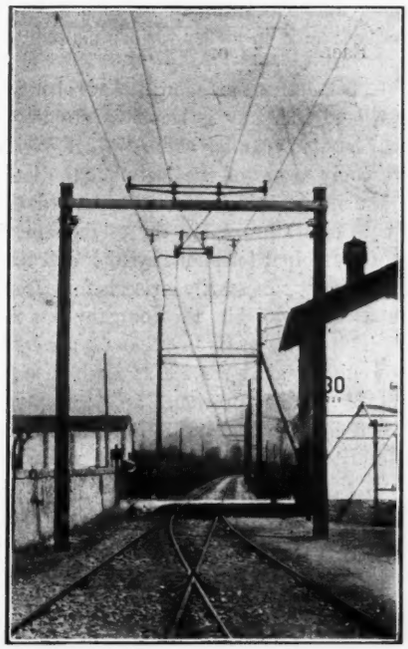


FIG. 14.— ARRANGEMENT OF THE OVERHEAD CIRCUITS AT A SWITCH POINT.

urban transit in the East, particularly the third-rail installation of the New York, New Haven & Hartford Railroad. Should the reports from these investigations prove to be favorable the change will be carried out according to modern ideas of heavy electrical operation. The contemplated advantages of the project are found principally in the way of passenger traffic, excursions and business and pleasure travel into the mountain retreats, which, as the road is now conducted, are not as satisfactory as they might be, owing to the smoke and cinders from the locomotives. Careful estimates in this respect make it probable that the railway company is losing a large amount of good patronage which might be had if a more cleanly means of locomotion were provided. Considering this disadvantage, the company last year experimented with coke, which, from an operating point of view, was not as satisfactory as was anticipated.

Possibilities of Water-Power Development in Sweden.

A report which has recently been issued by the Swedish Agricultural Department draws attention to numerous waterfalls in the country which could be successfully utilized for the development of motive power. It is estimated that the available energy of the principal waterfalls of Sweden is from 2,000,000 horse-power to 4,000,000 horse-power. The national coal bill for last year amounted to considerably over $15,000,000, and it is pointed out that this sum might be considerably diminished by the employment of the natural motive power possessed by the country.

American Automobiles in France.

The following is an interesting quotation from a French expert on automobiles:

"American vehicles are getting a strong hold among the English as well as some of the French and German aristocrats. The vehicles are sold at a good price and the profit must be very satisfactory. However, I predict that no sales on a large scale will be made until the Americans change their vehicles in some important parts. The principal objection is that they are constructed too lightly. They may be strong, just like your buggies, but people in general have no confidence. Your vehicles are superb for boulevard and park work—little promenades—but I think they could not stand a trip to Lille, Brussels or Bordeaux. The wheels are certainly not strong enough for such journeys. Another important point is the motor. I know of few American vehicles, steam or electric, which have over six-horse-power motors, while the smallest ones used here are eight-horse-power, while the 12-horse-power vehicles are mostly in demand. If some of your makers would come over here and inspect some of the factories like that of Darracq, Renault & Peugeot, they would no doubt get the right idea. The best way for them to find out that we, over here, are right is to organize some road race of 150 or 200 miles and they will see where they land on their fine roads."

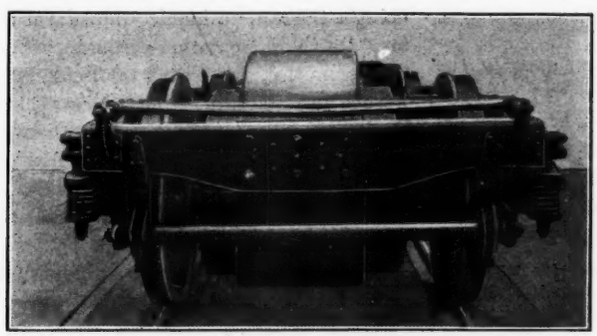


FIG. 15.—END VIEW OF GANZ POLYPHASE MOTOR TRUCK.

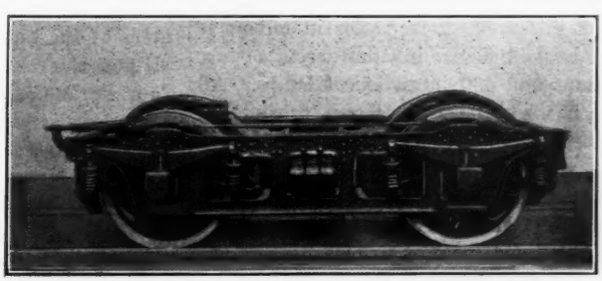


FIG. 16.—SIDE VIEW OF GANZ POLYPHASE MOTOR TRUCK.

News from Great Britain.

(From Our Special Correspondent.)

THE first supply of "wholesale" electrical energy in the United Kingdom under statutory powers has recently been inaugurated at Newcastle-on-Tyne, the centre of the northern coal mining industry. For the purposes of this supply the Newcastle Electric Supply Company has amalgamated with the Walker & Wallsend Union Gas Company, and the extent of their operations is shown in the accompanying map. The power station at present working at Wallsend generates current at 5,500 volts and a periodicity of 40 cycles. This is supplied to the substations which number eleven, and which are equipped with static transformers and synchronous motor-generators, enabling current at either 440 volts three-phase or 480 volts continuous to be obtained. When completed, the power-house will comprise eight Babcock & Wilcox boilers, two 300 brake horse-power Bellis engines, each driving 100-kilowatt 240-volt continuous-current generators; a 75 brake horse-power Bellis engine, driving a 50-kilowatt 240-volt continuous-current generator; four 1,400 indicated horse-power, triple-expansion engines, each driving a 700-kilowatt, 5,500-volt, three-phase alternator; one 1,500-horse-power Parsons turbo-alternator, 5,500 volts three-phase, and one 150-kilowatt, 5,500-240-volt, three-phase, continuous-current, synchronous motor-generator. In the area worked by the company are over 20 of the largest ship-building, engineering, etc., firms in the country, besides a number of small local bodies, for which provisional orders have been secured. In one works 500 horse-power in motors is to be laid down, in addition to 50 arc lamps and 500 incandescent lamps. All such works have their own substations. The opening of this system is looked upon as an important event in the electrical history of the country, and with many of the other authorized power schemes being well pushed forward, a good deal of leeway should be made up in this so long neglected branch of the industry.

The London United Tramways Company, the owner of the only electric lines in London at present, recently made a big public demonstration of its cars on the occasion of the completion of a full section of its system. The London County Council, however, is slowly pushing forward with the erection of its power station and the appointment of Mr. J. H. Rider, late of Plymouth, as chief resident electrical engineer, at a high salary, indicates that the tramway question is now being treated in a very serious manner.

The Government competition with the National company is being fought in no half-hearted manner at Tunbridge Wells. Probably aware of the fact that the local authority in this town has expended the whole of its grant for the establishment of a municipal telephone system, and that delay must necessarily arise before fresh funds are available, the company has reduced its rates by no less than 50 per cent, now giving a £4 service as against a £5 one by the corporation. £8 per annum was the previous charge. For the sake of subscribers who have hitherto paid too high subscriptions, this state of affairs is not to be regretted. The fight is being watched with great interest, as if the ratepayers object to increased taxes to maintain the competition the National Telephone Company will have scored.

The high prices of coal which so generally prevailed during 1900, are showing effects in the accounts of the various electric supply undertakings. In those concerns whose financial year ended on December 31 last year, or March 31 and May 25 this year, the same result is seen; *viz.*, increased working expenses per unit, in which the particular item which has increased most markedly is coal. At Sunderland, for instance, one expenditure on coal increased by some £2,500.

The water and gas companies in the areas of the numerous tramway schemes, all over the country, which have been before Parliament this session have been very busy trying to secure protection clauses against the corrosion of their pipes by electrolysis, and, as a consequence, "expert witnesses" have been having a glorious time in the committee rooms expounding their views—so often done before on the same subject. A final agreement is as far off as ever, and inasmuch as in some instances extra protection has been granted and in others refused, one side has secured no advantage over the other. The latest struggle has been over the London United Tramways Company's extensions, and in this instance it is pleasing to record that the sought-for restrictions have not been embodied in the bill. Naturally, the gas and water journals are sadly put out, and in support of their case point to Professors Ayrton, Perry, Dewer, etc., as sharing their views. But the adherents of the tramway company were equally "eminent," as witness the names of Sir William Preece, Professor Silvanus Thompson, Mr. H. F. Parshall, etc., who so confidently asserted, not that electrolysis is absent, but that the present Board of Trade regulations are sufficient protection against any damage to underground pipes.

The Metropolitan Railway Company, which received powers for the electrification of its present steam lines during the Parliamentary sessions of 1897 and 1900, has now sought permission for the ratification of the agreement with Mr. Yerkes, as mentioned in my last notes. But a serious and unforeseen difficulty has arisen in connection with the District Railway Company, which, together with the Metropolitan company, runs what is known as the "Inner Circle" line. The District company raises an objection to the proposed system of traction under the Yerkes agreement and themselves favor the Ganz high-pressure system. Obviously, two such distinct methods can not be employed over the same track, and after a good deal of controversy, the matter has been settled for the present by the insertion of a clause in the Metropolitan company's act that if within a month of the passing of such act the two companies have failed to come to an agreement, the Board of Trade shall appoint a tribunal to inquire into the matter. On the presentation of the report of the committee, the Board of Trade will issue a decision which must be accepted by both parties as final. The District company requested that, in the event of the appointment of such a tribunal, it should not be composed of electrical experts on the plea that all electrical experts have made up their minds in favor of what the daily papers have called the "Yerkes" system.

In contributing still a few more comments on the International Exhibition at Glasgow, I would draw attention to a matter which has been but slightly mentioned over here; *i. e.*, the numerous monopolies granted by the authorities to trading individuals. One which affects all newspaper work seriously is that in connection with the taking of photographs, and the consequence is that one is asked to pay exorbitant terms by the

firm which has secured this monopoly. Not even an exhibitor is permitted to use a camera to photo his own stand, and this state of affairs in such a den of municipal trading as Glasgow is astounding and unfair.

Messrs. Easton & Company, successors to the old firm of Messrs. Easton, Anderson & Golden, have fitted up two lifts to enable visitors to view Glasgow and its environs from the roof of the exhibition. The chief feature of these is the controlling switch mechanism which is of a new design, patented by their chief engineer, Mr. Björnstád. Each landing place has a push-button, and there is a corresponding push inside the car. Thus, the lifts are practically automatic in action, as the pressing of a button on a landing brings the car up to that floor, but the arrangements are perfectly safeguarded, inasmuch as the whole system is rendered inoperative unless all landing gates are properly closed, as also is the door to the car itself. Messrs. Crompton & Company, in the power supply department, have a 1,000-kilowatt dynamo, equipped with 12 poles and 12 sets of carbon brushes, and carrying an armature weighing 19 tons, which is considered of sufficient mass to obviate the addition of a flywheel. Messrs. Willans & Robinson have a novelty in the shape of a completely proportioned Willans engine of only 14 brake horsepower actually running at 1,000 revolutions per minute, and coupled to an 80-volt dynamo. It is only some two feet in height and causes a deal of amusement.

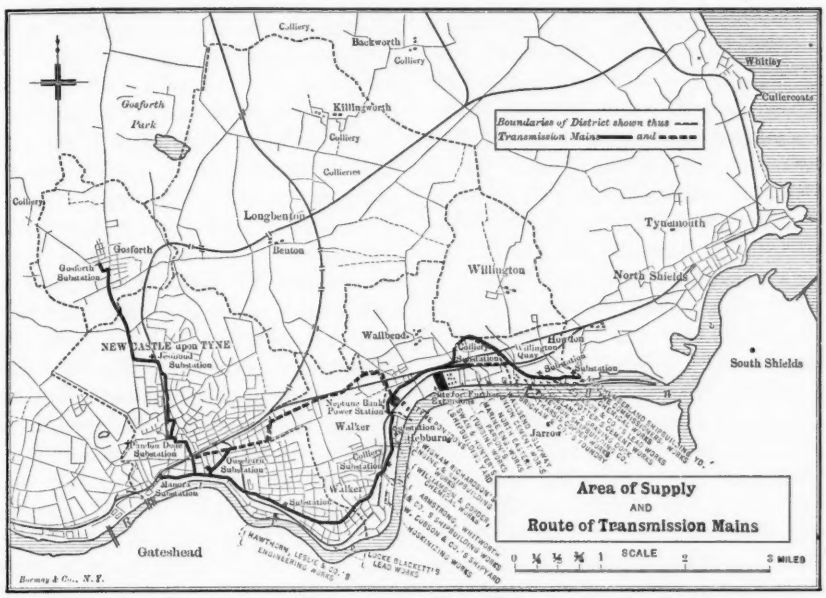
Mr. J. H. Rider, the London County Council's resident electric tramway engineer, has been elected president of the Municipal Electrical Association for the coming year. Next year's convention will be held in London. About the same time in 1902 a number of events of interest to electrical engineers will take place in London. The tramways and light railways exhibition last held in June, 1900, will be repeated, and the International Tramways Union will, for the first time, hold its annual gathering in the capital, in conjunction with our own Tramways and Light Railways Association.

An English company has now been formed, bearing the title of the "Lodge-Muirhead Wireless and General Telegraphy Syndicate," to acquire certain patents belonging to Drs. Lodge and Muirhead. The first directors are Dr. A. Muirhead, H. J. Muirhead and F. L. Muirhead.

It is anticipated that work in the National Physical Laboratory will be commenced early in October. The buildings are nearly completed and the staff has recently been appointed.

The motor-car trials which will take place at Glasgow early in September are under the control of the Automobile Club of Great Britain and Ireland. The important factors in these trials will not be speed, but endurance and reliability. The judges committee includes Sir William Preece, K. C. B., Professor Hudson Beare and Mr. W. Worby Beaumont. Previously to these tests, the club will undertake its annual tour for which Ireland has this year been selected.

London, July 20. A. W.



SUPPLY LINES OF THE NEWCASTLE-ON-TYNE ELECTRIC SUPPLY COMPANY.

Views, News and Interviews

Covered wire was first made for milliners' use. The first electrical insulated wire was made by Señor Salva, of Barcelona, in 1796.

A curious story comes from Geneva, Ill. It appears that Mrs. Amelia Jane Howe has been induced—the account does not say what the inducement was—by the Chicago & Wheaton Electric Railroad Company to apply for a divorce from her husband. This was done to obtain an unclouded title to a certain section of land in the railways right of way. It may be said, in passing, that the lady in question has been separated from her husband for 17 years.

A new rival to the electric light has appeared in Lyons, France, where Professor Raphael Dubois has successfully cultivated phosphorescent marine microbes. Everybody is familiar with the phosphorescent creatures which tropical seawater contains and it appears that this learned professor has succeeded in cultivating these microscopic jelly fish and making them shine to order. It is stated that he has obtained enough light from the glass flasks containing them to render a printed page easily legible and that photographs may be taken by the new light, although its actinic power is decidedly small.

Insects and the X-Rays.

A box was made half of wood and half of sheet lead. In the wooden half a number of larvæ of flies, bees, beetles, and other insects was placed, and the box was then put in the field of the X-rays. The insect colony at once became greatly excited, and after crawling to and fro, finally emigrated, to a worm, to the leaden half of the box, where the rays could not penetrate. The experiment was repeated many times and always with the same result. A similar experiment was tried with the blind larvæ of a certain species of beetle. A number of them were placed in an open cigar box, which also contained a metal box with an opening. No sooner were the rays turned on than the insects showed signs of distress. Their uneasiness increased, and in a little while they all sought refuge in the metal box. As the larvæ in the second experiment were entirely sightless, their perception of the rays must take place through the nerves of the skin.—*The American X-Ray Journal.*

THE CULTURAL VALUE OF ENGINEERING EDUCATION.*

BY FRANK O. MARVIN.

At the very outset of this discussion is encountered a great difficulty. What is culture? The writer has been asking this of his friends. An answer has been sought for in the printed page where is recorded the best thoughts of the best minds. Great thoughts and lofty ideals have been disclosed, but nowhere has been found a satisfactory definition, a phrase or paragraph that succinctly and clearly sets forth the heart of the matter.

People often recognize, appreciate and reverence its possession without being able to fully analyze and set down its elements. There is something subtile and emotional about it that eludes a close pursuit.

The reason for this perhaps lies in its essential individual quality, in its being the result of a personal life, developed, it is true, on lines similar to those used in other lives, yet including something that pertains exclusively to the human unit that is different from all other units.

Nevertheless, there seems to be certain fundamental qualities which must be possessed before a man can be classed with cultured people, qualities which are only acquired after a considerable experience in life, but which are influenced greatly by the years of student training and therefore fit subjects for discussion here. Far be it from the purpose of this paper to attempt a definition of culture or a setting forth of its elements in any completeness; rather the emphasizing of some things that relate to it, especially with reference to the education of young engineers.

1. The man of culture must be a thinking and reflecting being. There must be not only the ability, but the habit; and this is no easy thing to acquire. Modern American life is full of hurry, full of affairs that demand instant attention, and one matter follows another with rapid succession. We get news from Pekin to-day, from Havana to-morrow and from the Philippines within a few hours. We build railways, erect bridges and fill large orders for locomotives for foreign shipment in such short space of time as to astonish the world. Men seek short cuts to fortune. In the popular opinion, the men who act quickly, the men of decision, are those who succeed. But there is a danger here. For, back of the action, behind the sharp decision, must lie a mature judgment, and how else is this to be formed except as a result of deliberate reflection. However quickly one may reach a conclusion, its correctness or faultiness will depend not on intuition, but on the degree of true comprehension. The decisive act which is also right rests on a process of thinking and judging that has been long fostered, until it has become a habit, until there are established certain standards by which things are to be measured.

The early steps of this training are necessarily slow, and we, as teachers of engineers, must recognize this and not yield to the temptation to crowd our students over too much ground on the one hand, or, on the other, to lead them through short cuts across country by empirical paths that may give them ease and quickness of travel, but little or no reason why the path is chosen. Let them go the long road. I do not by any means wish our teaching to be non-practical—rather more practical in the best sense; but first, last and all the time, let students be trained to do their own thinking and to form their own judgments; to test the statements of others by the workings of their own mental processes.

2. There is another element of culture that comes in here, an ethical one, that of forming right judgments. Men may have the appearance of culture without its true spirit, which is essentially honest. This is especially important, as culture seeks to make a man's life satisfactory to himself when measured by his own conscience, as well as successful in the field of affairs. So his standards must be based on sound principles of right and wrong; and it is only when these are so placed that his life becomes one of freedom, freedom from the bondage that wrong thinking and acting always bring. A class room is no place to preach a sermon, but there can be there imparted a respect for truth and perfect honesty. A teacher's attitude should always be open and frank, that of a sincere seeker after truth. He should never dodge an honest question, and be ever ready to say "I do not know," if he does not. There is an incalculable power that "makes for righteousness" and the happiness of the after life of the student in the true teacher's conduct of even such a material subject as mechanics.

Back behind the subject, with its subdivisions, its formulæ and rules, lies something larger, a sort of spiritual quality that binds it to all other subjects, to the universe as a whole, and makes it a part of the truth of God's realm. The student that gets hold of this significance learns much more than facility in the manipulations of processes or the application of principles. He gets something that makes his life richer and better and his mastery of the subject more complete.

3. There can be no true culture for a man that does not work, that does not put his cultivated powers to some useful service; and here there must be such degree of mastery over the chosen profession or business as will result in a special skill and dexterity—a doing of some one thing better than others can do it. A man expresses himself through his work, and whether he will or no, he thus discloses to all who know him his own peculiar qualities. It is this intensity of application, this concentration of purpose and directness of aim, that gets the world's work done. Here in early years the engineering student has the advantage of the student in arts. Study for knowledge's sake may be stimulating to the few, but for the many there is needed the goal of a special calling to secure the close application that results in ability to concentrate one's energy to the attainment of a certain end. But here again comes a danger, that of too early, or over, specialization, and the following of short cuts to professional life that are advocated by some who, in the eyes of the world as well as in their own, have been eminently successful as specialists. Whether these can be called men of culture of the highest attainments is another matter. The extreme specialist may be supreme in his own line of details, but may fail when there comes up a question involving the relation of his specialty to other things. Even within his own domain, his conclusions will be modified by his general knowledge and experience. All one-sided people, whether they be linguists or naturalists, poets or merchants, preachers or engineers, are quite liable to the forming of erroneous judgments. To the few geniuses, whose capacities and powers seem to be abnormally developed, though of limited scope, much is forgiven; but for the average man of the day there is demanded an ability to form good and wise conclusions.

4. In order to form those that are appropriate and correct there is needed, then, breadth of view—a quality that has been expressed by the word poise. A man of poise, of even balance, will see things in their right relations and due proportions; he will weigh matters, giving to each component part its just degree of importance. He will the better understand the motives that underlie other men's actions and the more readily use them to suit his own purpose. He will be more apt to rightly interpret the new movements in the world of thought or action and can seize opportunity for a personal advantage or a larger

* Address of the president of the Society for the Promotion of Engineering Education, Buffalo meeting, June 29, 1901.

sphere of service before others see that there is such.

This demands a considerable range of knowledge. Not the close mastery of many lines in all their details, but a fair degree of familiarity with their general phenomena and principles; and there is scarcely any field that will not contribute something to the result. It is admitted at once that the average man is of limited capacity and unable to grasp a comprehension of all knowledge that may influence his life and work; what is pleaded for is such degree of breadth as may be needed to make one of great efficiency in his chosen profession and of most value to himself, not only in a financial way, but also in the sense of gaining a joyful recognition of the worth of developing all the powers that one has.

The value of mathematics and the physical sciences, with their application to technical things, needs no discussion here, for these are the engineer's tools; but it is a fair question whether, in our desire to graduate students that can be early useful, we do not place too much stress on technical things to the exclusion of others that give greater breadth of training. We must not forget that we are educating men for a life; that we must look forward to the time when these young people will be 50 years old, and at the period of their maximum productiveness as workers and of maximum value in society and as citizens.

Engineers have to deal with other things besides materials and physical laws; they must manage men and matters of finance. If they are to rightly influence those whose capital they are employed to expend, they must be able to meet them socially and intellectually, to discuss intelligently matters outside the pale of strictly professional life. Evidence of professional ability and skill is, of course, first demanded, but breadth of culture creates an added confidence in the wisdom of the conclusions reached and the advice given.

Heretofore much of our engineering work has been concerned with the opening and developing of new country or new business and industrial enterprises. So engineers have found their work away from contact with men. But engineering practice is changing, as conditions become older and more settled, and more and more practitioners find their work in communities and busy centres of trade where they are constantly thrown into close contact with strong and cultured men. Present engineering courses do little to prepare a man for this thorough instruction concerning human nature and human relations. Something of history, economics and sociology should be included.

5. It is not sufficient to form correct judgments only; there must be added a skillful and effective presentation of them in well-chosen and fitting English. The ability to do this involves more than training in the writing of compositions, themes, forensics and reports. The cultured man should have a taste for reading the best that has been written in his mother tongue, and for several reasons: The great thoughts of great minds are stimulating and broadening to his own mind; he thereby absorbs a knowledge of words and their shades of meaning; he gains an appreciation of style and insensibly better knows how to form his own; and, not least by any means, he makes of his books friends that are life-long, that cheer and console him under all happenings, adding much to his internal resources for happiness.

The time given to English in our courses is not enough to train students properly in its use and at the same time open the doors to our best literature. It may be said that all this English work should be done in the preparatory school, and it is probably true that the character and quality of the high-school English is better to-day than it has been heretofore. Yet it seems to me that engineering students should have some training of a college grade along the line of literature.

6. To the writer's mind, there is another element of culture that should enter into an engineer's training—*viz.*, an appreciation for beauty. As he has said at another time* the engineer is a designer, and it is important that he should embody his design in artistic form if he is to fulfil his whole mission and please and gratify others by the perfection of his work. The engineering student devotes a good share of his time to the drawing-board, and much can be done here toward the cultivation of this quality by an instructor who possesses it, without lessening at all the amount or force of the technical exercises for which the process is primarily used. There should be, however, something further by way of giving instruction in elementary æsthetics and by opening the students' eyes to what is beautiful in nature.

7. The possession of agreeable manners and tact is another evidence of culture, not merely the conventional bearing of polite society, though this has its value. This alone is but a husk which must cover the real kernel, refined and gentle feeling; and such feeling is the result of moral and intellectual convictions. Manners, then, are not to be taught from a text or by lecture; they rather follow as a consequence from the whole course of training and are crude or refined, just as the character of the instruction makes them. The teacher's personality has very much to do with this matter. If he is of coarse grain, of domineering or selfish disposition, his influence will not tend toward the production of true gentlemen.

And now for the real question—does engineering education tend to produce culture? According to old standards, when men limited culture chiefly to a knowledge of language, literature and philosophy, the reply would be in the negative. However, standards are not the thing itself, only methods of measurement; moreover, standards change. Science has modified and is still changing the ideas of culture that men hold, and this evolution makes it all the more difficult to find a common ground upon which all can stand when considering things concerning it. This much is clear, however, that no one existing course of educational training has a monopoly of cultural methods; nor will the college course necessarily secure its attainment because of its personal quality. Further, culture is the result of a life, and the most that can be expected of a college course is to open the students' eyes to its real worth, to start them rightly with certain leanings and aptitudes, and furnish them with the means of a continuous growth toward its maturity.

It is maintained that an engineering course can tend in this direction, and that in some of our best colleges, under the instruction of people themselves cultured, it does so tend to-day. Our best engineering courses are stiffer and more exacting both as to time and effort than those in the college of arts, and the resulting acquisition of mental power and the ability to focus it proportionately greater.

The fixed course, with its correlated parts and the certain definite ends to be strived for, is advantageous. The training is a continuous testing and trying of the truth of knowledge, and teaches the student to ask "why," and to reflect. He gains respect for nature's laws, and learns that his professional success will depend on his ability to work in harmony with her. He gathers a fair degree of knowledge of himself, his strong points as well as his limitations. He acquires a habit of thought and action that leads to further growth. He learns how to adapt means to an end, and within what limits of precision to work that it may be reached with economy. In short, he becomes a trained and educated man, cultured to a certain degree, but with limitations; just as the arts student who has specialized to

* *Proceedings* of the American Association for the Advancement of Science, vol. xlv.

a like degree in language and literature, with little of science training, becomes cultured, but also with limitations. Let the latter retain his A. B. On the other hand, let it be recognized that the engineering B. S. stands for culture as well, of equal worth and value, though of different kind.

As between the two specialists, I think the advantage lies with the engineering graduate as being on the whole, better equipped for a life of useful service and one that will possess the greater capacity for further development.

As one looks forward ten or twenty years and attempts from present tendencies to forecast the work and social standing of engineers, he must see that the profession will be doing a larger work and exerting a greater influence.

Further, that an engineering training will be more and more recognized as the one best fitted to lead to positions of an executive nature in connection with industrial enterprises, and in the administration of public works. Everywhere will be demanded expert skill, sound judgment and broad views, primarily because these will be found to be economical. The entire class of men that a recent writer has called "mattoids," the ill-trained, narrow and egoistic, will be pushed out because their service is costly.

There are two tendencies in the present-day engineering education that are, in my judgment, opposed to the desirable result. First, a tendency to crowd too much of the foundation work back upon the preparatory school already overloaded. This society's committee on entrance requirements has advised a standard which is high enough. Second, the allowing of technical subjects to crowd the fundamental general ones from the college course, in a vain attempt to do what from the very nature of the case can not be done, make an engineer by college study. The result of this in some institutions is further seen in too early a differentiation between the various engineering courses; so that, for instance, the civil student knows nothing of applied electricity, and the electrical student nothing of surveying, while neither has a chance to acquire a taste for literature.

The whole problem is an involved and complicated one, but there is a way out that must be found if the engineer is to fill the important place that awaits him. One part of the solution will be probably found in a refining of the methods of instruction, so that better results may be reached in the same time. In the end, however, the writer thinks that there must come a deeper sense that after all life is long, that it should be taken with more of deliberation, and that it is the end that is important, rather than the beginning. The feverish rush and haste to be earning must be replaced by a recognition of the real necessity for a full-rounded-out preparation if the largest and best service is to be given. Then the student will be glad to spend the one or two extra years in college that may be demanded. The wise student now will do this without its being required.

The Chief Justice of my own state has said, "The spirit of an age is that which makes finally for the happiness of the race. I have absolutely no fear as to the final end of things, nor as to the steps and incidents of evolutionary development. The aspirations, the great universal possessions of a people, can never move them to other ends than their happiness and good. The spirit of this age is commercial enterprise and conquest, and as to it I have an unspeakable conviction that it will, as the spirits of other ages have done, work itself into forms and institutions of beauty and eternal worth to men."

It is largely through the engineer that this is to be done. The finest result requires the most skillful labor; the noblest workman demands the most fitting training.

Herein lies our responsibility.

The Decadence of Isolated Plants.

To the Editor of the Electrical Review:

My attention has been called to an article in your issue of July 27, entitled "The Decadence of Isolated Plants," and it is my desire not to permit the broad statements contained therein to go on record unchallenged.

I do not agree that the isolated plant is giving away to the central station. The isolated plant is becoming more and more popular every day; there are good reasons for its existence, and I am satisfied that if some of the present large consumers of current from central lighting plants took the trouble to investigate they would lose little time in installing their own power plants for the generation of the electric current that their establishments demand.

Most of the central station plants are loaded beyond their capacity, the current supplied by them is of lower voltage than required to give the ordinary incandescent lamp its proper brilliancy, and there is a constant flickering of the lamps due to the fluctuation in the demands for power.

I admit that where the consumption of current is small, or where the current is used but for short periods of time, and in a few other instances depending on the nature of the establishment, the central station can supply current at a less cost than that for which the consumer could generate it, but I do not believe this occurs in 90 per cent of the establishments using electric current.

During the past six years I have had occasion to make investigations of a large number of establishments to determine the advisability of installing isolated plants, and to determine by tests the cost of generating current, and I feel safe in saying that in more than 90 per cent of the plants investigated I have found it more economical to install the isolated plant. I have found in a number of cases that the proprietor of an establishment could save money by operating his own plant, if of only 125 kilowatts capacity.

In one particular case the boilers were already installed for supplying steam to elevator pumps, etc., and a fireman and chief engineer employed; the proprietors were paying seven thousand dollars per annum to the central station for electric lighting. It was found that by installing their own generating plant that they could double the number of lights in their establishment and greatly reduce the cost for current. The plant has been in operation now for two years. Its first cost necessitated an expenditure of approximately fifteen thousand dollars. The present yearly cost of operating this plant, which supplies current for lighting, is seventeen hundred and fifty dollars, the plant operating 10 hours per day and 310 days per year. Taking into account the current rate of interest on the investment and a reasonable percentage of the first cost for depreciation you can readily see the enormous saving effected by the installation of this isolated plant.

In another establishment, where the yearly cost for current from the central station was about four thousand dollars, an isolated plant was installed, and allowing four per cent compound interest on the capital invested and a depreciation on the plant of 90 per cent in 10 years, at the present rate the saving in 10 years by the isolated plant will amount to almost twelve thousand dollars.

A recent investigation showed that in a certain apartment house the management could have installed its own plant, and, as before, allowing interest and depreciation, maintained its public lighting; *i. e.*, lights in corridors, street lights, ele-

vator lamps, basement lights, etc., without cost, and by charging the tenants one-half the present rate charged by the central station, added almost four hundred dollars to its yearly income.

I could cite many more cases where the isolated plant furnishes current at a less cost than is possible by use of current from the central station at the present rate charged, but the above instances, together with the fact as I have stated above (that in 90 per cent of my investigations I have found the isolated plant more economical), will suffice to prove my assertions.

The isolated plant is not "rapidly becoming a sort of curiosity," there are valid reasons for its existence, and its survival is not "due to lack of understanding."

E. S. BOYER.

New York, July 30.

New Electric-Power Scheme for Ireland.

The preamble of the Shannon water and electric power bill has been passed by the House of Lords. The measure, which is an important one in its bearing on the industries of the west of Ireland, proposes to incorporate a company with a capital of £360,000 and £180,000 borrowing powers, and empower them to carry out a scheme to utilize the waters of the River Shannon for the purpose of generating electricity, and to supply energy for lighting and power purposes over an area of 30 miles radius from the power station, to be situated four and a half miles from Limerick. The works to be constructed under the bill consist of a short canal to carry the waters of the Shannon to the generating station to be erected at Cloonlara, where a fall of 40 feet is obtained. The water will be returned to the Shannon at a point six miles below the intake. The promoters expect to find their best customers among the industries in the city of Limerick, and have entered into an agreement to supply the tramway company of the city with energy in bulk, and it is expected that the corporation, which supports the scheme, will also take the current necessary for the lighting of the city. The bill has already passed the House of Commons.

The latest move in electrical matters in Italy is the installation of three aluminum electric transmission lines. These transmit power at 3,000 volts from three-horse-power turbines to the valley of Pompeii, to Larno, and to Torre Annunziata. One of the lines is nine miles in length, while the remaining two are two miles long, respectively.

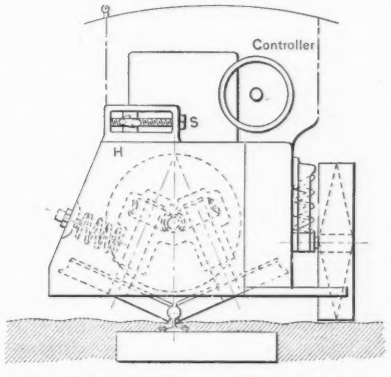
ELECTRIC CANAL TRACTION IN FRANCE.

BY M. FABRE.

In 1889, on a canal of northern France, it was attempted to tow boats by steam locomotives running on an ordinary track. The first cost of this system was too large and the company could not compete with horses.

In 1898 an electric (direct-current) system was installed on a 57-kilometre section of canal in France, and in 1900 the same system, but using three-phase current, was installed in Belgium. The August 1, 1900, issue of the ELECTRICAL REVIEW gives a full description of this system. But the results have not been what was hoped by the authors of these schemes. The heavy tractor has a poor efficiency and destroys the towpath.

A German company recently devised a system consisting of a monorail track



SKETCH ELEVATION OF ELECTRIC CANAL TRACTOR.

and ordinary electric locomotive with only two wheels on the rail. The adhesion of this tractor was found to be insufficient, and a rack was necessary to the good operation of the system.

The monorail electric system recently patented by M. Fabre gives a solution of the difficulties met with in the canal traction, its chief advantages being low cost of establishment, lightness of tractors, good adhesion and no maintenance of towpath.

The tractor is provided with four oblique driving wheels, running on the monorail. The entire tractor can oscillate around the circular-shaped rail as an axis. On the canal side, a supporting wheel keeps the tractor upright.

The electric motor sets the driving wheels in motion by means of worm or conical gears:

1. Because of the obliquity of the wheels, the weight, w, of the tractor is resolved in four components parallel to the wheels, and the rim of these components, equal to $\frac{w}{\sin a}$ (a is the inclination of the wheels), is available as adhesion.

2. The obliquity of the traction cable forces two diagonally opposite wheels against the rail, and this pressure is also available as adhesion.

This adhesion increases with the strain on the cable, and, for a given strain, can be increased to its most favorable value by shifting the cable hook, h, by means of the screw, s.

For instance, a strain of 1,200 kilogrammes (which is the tractive effort for a string of three boats of 290 tons at a speed of two miles an hour) gives in this way an adhesion of 800 to 1,600 kilogrammes, according to the position of the hook.

This assumed effort of 1,200 kilogrammes would require, on an ordinary track, a tractor weighing about eight tons, and on a monorail system an ordinary tractor weighing nine to ten tons, while a locomotive of the Fabre type weighing only 2.5 tons will be sufficient.

Of course, a rail for a tractor of 2.5 tons can be laid much cheaper than a rail or an ordinary track for tractors of eight to ten tons, and the question of first cost is of prime importance in the practicability of any system.

In the application of this system, which is to be made in France, three-phase currents will be used, the rail being taken as a conductor. Two normal speeds will be available with only one motor, a three-phase motor running at half-speed when two phases of its secondary are open-circuited. In this way the tractor will have the same advantages as a tractor provided with two direct-current motors using the series parallel regulation, or two three-phase motors using the cascade regulation.

Electrical Progress in India.

Great strides are being made by electricity in India. The most important scheme at present planned is the installation of the combined electric punkah pulling and lighting of the barracks and hospitals of the British troops in India. The demand for electric ventilators largely exceeds the supply in British India. American manufacturers are handicapped by the fact that a preference is shown for ventilators with blades from four and one-half inches to six inches long, while those of American make are only about three inches long. The establishment of a depot for automobiles in Bombay is also under consideration.

Interurban Electric Railroads.*

And this leads us to the greatest problem before the interurban railroad engineer; *viz.*, How to provide the average rural district with the advantages of rapid transit and still bring to the investor a fair and proper return for his money. From the official reports from the State of Massachusetts we learn that the average cost of a mile of electric railroad in that state has been as follows:

Roadway and track	$23,433 43
Car equipment	8 510 13
Electrical equipment	11,683 82
Total	$43,627 38

It is proper to state that these figures include both urban and interurban railroads. We have many examples of the latter, however, averaging about as follows:

Roadway and track	$10,000 00
Car equipment	2 000 00
Electrical equipment	8,000 00
Total per mile	$20,000 00

The well-constructed urban lines are operated on 55 to 60 per cent of the gross earnings, but the interurban roads are running higher, say 66 per cent; although as earnings increase we may expect a corresponding decrease in this percentage. At this rate the gross earnings must be $3,000 per mile of road to pay interest. Most of the roads already built will earn this or more, but we must remember that the best territories are now occupied and our operations in the future must be in fields not so inviting, because the population is less dense. In this connection it may be interesting to note that the latest official reports of the operations of the electric railroads of Ohio, New York and Massachusetts show the following gross earnings. For the fiscal year ending June 30, 1900, 960 miles of urban railroads of Ohio earned an average of $10,193 per mile, and 390 miles of interurban roads earned $3,824 per mile; while the average gross earnings of all the electric railroads, both urban and interurban, were $8,354 per mile, against $10,452 for Massachusetts, and $24,445 for New York. In the latter state the urban railroads earned $29,613 per mile and the interurban $4,727 per mile.

It seems unwise to undertake to build a less expensive roadbed and track for the growing exactions of the traveling public; rather does the keen competition of the steam roads compel us to provide good alignment, easy grades, and a perfect track. It is a generally recognized fact that a high-grade roadbed and track are absolutely necessary if maximum earnings and minimum expenses are to result, and in this connection we unhesitatingly recommend securing a private right of way whenever it is possible so to do. As with the roadbed, so with the car equipment. We can not safely economize in its cost, therefore power and power transmission seem to present the only chance we have for reducing the cost of construction.

In the generation of power and the transmission of the same I am satisfied that our mechanical and electrical engineers have been devoting their attention more to the efficiency of the service and the economy of operations than to the minimizing of first cost. It is true they are embarrassed by the absence of competition due to the formation of trusts and combines controlling machinery and materials, but this in time will regulate itself. I believe, however, that there is much which can and will be done in the near future in the way of reducing first cost of power and its distribution. If we are to serve the average rural district as we would it is absolutely necessary that economies in first cost shall be introduced. Just what form these will take it is difficult at this time to prophesy; whether it will be compressed air, the storage battery, or the familiar trolley with four-motor equipment we do not know. One thing is certain. We can not serve the rural districts fully until we can give them first-class transportation service with a smaller expenditure of capital.

To increase the earnings is a different problem. To the writer the volume of earnings of some of the existing lines is a constant source of wonder, and he confesses to having mentally prophesied failure in a number of cases where success has attended the actual operations. It is a singular thing how business is actually created where there was promise of little or none by supplying facilities which the public has never felt the need of. It seems the denizens of the rural districts are quick to realize that it is cheaper to send the women on their shopping trips by the trolley than to withdraw horses and a driver from farm service.

Up to this time practically all the earnings have come from passenger business. In the future we may look for a big source of revenue from freight. Already many of the lines are establishing regular freight service. The telephone in connection with the trolley freight permits of quick deliveries and the merchant and his customer will not be slow to take advantage of it. Recently an enterprising inventor has put out what he terms a "rail wagon," which gives promise of being a good thing for the interurban railroad and its patrons. Briefly stated, this wagon is intended to run between the farmyard and the city warerooms. It is provided with four standard car wheels for rail transit and with four additional wheels with broad tread adapted to highway travel. Its capacity is about six tons and is so constructed that any product of the farm can be conveniently and quickly transported to the nearest market without breaking bulk. At the simple and inexpensive transfer sidings provision is made for minimizing the dead load for animal power by cutting out the rail trucks, so that two or four horses can move the wagon to and from any portion of the farm, depending on the condition of the roads.

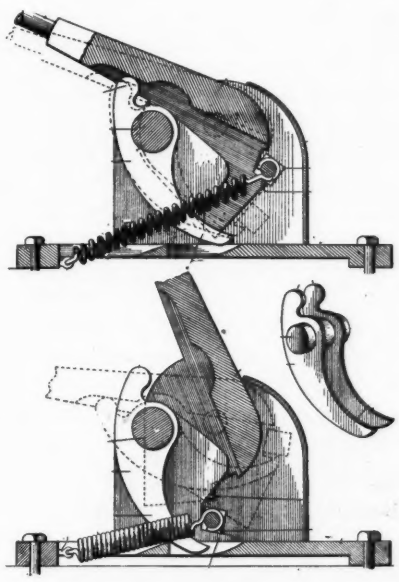
* Extract from an article by Mr. Walter J. Sherman, C. E., in the Transactions of the Association of Civil Engineers, Cornell University.

Electrical Patents

An exceedingly ingenious trolley pole has been devised and patented by John H. Beckert, of St. Louis, Mo., the improvement residing in novel means for disengaging the supporting springs from the trolley pole when it jumps the wire, so that the pole will drop to a position beneath the same. In carrying out this idea, the usual pivoted pole is provided, with an enlarged heat at its lower end, which head has a notch. In this notch is detachably seated a cross bar, to which the supporting springs are secured. This bar normally retains its seat in the notch and holds the trolley against the wire, but when the trolley arm disengages from the wire it will be raised to a vertical position, whereupon the cross bar hits against an inclined abutment and is thrown out of the notch. The pole, therefore, being released, drops to a practically horizontal position and out of the way of cross wires. The means for throwing the cross bar back into the notch is also ingenious. A lever is pivoted beneath the lower end of the trolley pole, with its lower end located beneath the cross bar, when the latter is in its dislodged position, while its upper end is in the path of the trolley pole. Therefore, when the conductor pulls downwardly upon the trolley pole the lower end of the lever will be raised, thereby forcing the cross bar upwardly and into a position where it will drop back into the notch of the trolley head.

The Boston Electric Hose Signal Company has been working on novel means whereby a fireman at the nozzle of a line of hose can signal the engineer at the pump. In these electric hose signal systems it

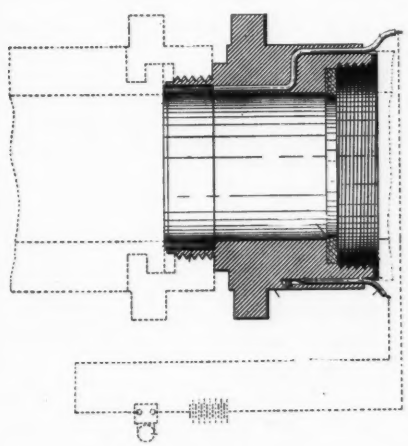
has been customary to provide a line of hose with wires running along the hose and with couplings having circuit terminals or connections, whereby, when the parts thereof are screwed together, a continuous circuit is formed the entire length of the line of hose. A circuit-operating



Trolley Pole.

device has been provided on the nozzle, which is within easy reach of the hoseman for operating, and a battery and an alarm have been located on the engine. In the system, as generally constructed, the couplings themselves have been included in and formed part of the circuit, and the coupling which is used to connect the line of hose with the engine has been made just the same as the couplings which connect together the sections of hose and form the line. As a result the engine has been included in and thereby forms a part of the circuit at one side of the battery, which in practice has been found to be very objectionable and, in fact, under ordinary conditions, totally impracticable, owing to the many opportunities for short-circuiting and grounding the signaling circuit at the hose couplings. A late improvement on the system has been devised by Howard Sargent, of Boston, Mass., which is aimed to overcome this objection by cutting out the engine entirely from the circuit. To this end a separate coupling is provided which is attached to the usual nipple of the engine and remains a permanent fixture thereon. This coupling is made of insulating material and is adapted to receive any one of the couplings of the hose. The coupling consists of a shell having an internally screw-threaded ring of hard rubber or other insulating material at the inner end, which is adapted to engage the usual nipple on the engine, and, by reason of said ring being composed of insulating material, the coupling will be completely insulated electrically from the engine. Two terminal wires are attached to the coupling, which are insulated from each other, and the terminal wires are connected to form a loop, and a battery and an alarm are located on the engine and included in this loop. The outer end of the coupling is formed to receive any usual coupling and it has circuit terminals which will engage and cooperate, respectively, with a coupling adapted to be received upon it and with a circuit terminal carried thereby.

A new insulator for electric wires, that embodies several points of novelty, has been patented by Mr. John P. Sharpe, of Oneida, N. Y. The body of the insulator is made of glass or porcelain, and has a central bore terminating short of the top and having offset notches. In this bore



Electric Hose Signal.

are located two stems or standards having lugs that engage in the notches and provided at their lower ends with feet which are secured to the cross bar of the pole. The outer face of the body has a transverse notch through which the wire to be supported is passed. A plate fits over this notch and has its upper end seated in a socket, the plate being held in place by a metallic ring that is slipped over the body. It will therefore be seen that there is a novel means for attaching the wire supply as well as a new form of support for the body.

It may be interesting, as showing the value placed on patents by the large electric companies, to know that the General Electric Company alone took out 57 patents during the month of July.

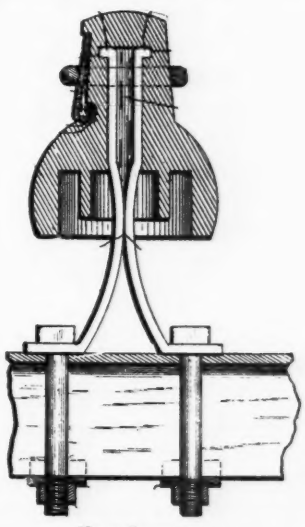
Convention of the Indiana Mutual Telephone Association.

The Indiana Mutual Telephone Association held its annual meeting at the Lahr House, Lafayette, Ind., July 30. The first session was called to order at 2 P. M., when an address of welcome was made by the Hon. N. H. Justice, Mayor of Lafayette.

The paper of the day was read by the Hon. Louis C. Walker, of Indianapolis, and was entitled "The Late Bell Monopoly—It Lived Unloved and Died Unmourned." Mr. Walker's paper was a very able presentment of the independent side of the long controversy. It went into no little amount of detail concerning the telephone conflict in Indianapolis, and was received with enthusiastic approval by those present.

The afternoon was spent in a trolley ride to the State Soldiers' Home and around the city, the delegates being the guests of the Sterling Electric Company. In the evening a trip to Woodlawn Park, where a vaudeville entertainment was witnessed, was made under the same pleasant auspices.

The second day's proceedings were opened by the annual election of officers. Mr. L. A. Frazee, of Connersville, was chosen president; Mr. C. A. Zion, of Lebanon, vice-president, and H. B. Gates, of Indianapolis, treasurer. A paper by the Hon. G. P. Hayward, of Lafayette, entitled "Our Friends the Enemy," was



New Insulator.

read; but a paper on the programme by Mr. George W. Beers, of Fort Wayne, was omitted on account of the author's absence. After hearing several addresses, the convention adjourned to take a steamboat trip on the Wabash River. A banquet was the closing feature of a remarkably successful and satisfactory convention.

Meeting of the American Association for the Advancement of Science.

The preliminary announcement of the fiftieth annual meeting of the American Association for the Advancement of Science, to be held at Denver, August 24 to 31, 1901, is now being sent to the members by the permanent secretary, Mr. L. O. Howard, Washington, D. C. Charles Sedgwick Minot, of Harvard University, Cambridge, Mass., is the president for this meeting. The following are vice-presidents in charge of departments:

Mathematics and Astronomy, James McMahon, Cornell University, Ithaca, N. Y.

Physics, D. B. Brace, University of Nebraska, Lincoln, Neb.

Chemistry, John H. Long, Northwestern University, Chicago, Ill.

Mechanical Science and Engineering, H. S. Jacoby, Cornell University, Ithaca, N. Y.

Geology and Geography, C. R. Van Hise, University of Wisconsin, Madison, Wis.

Zoology, D. S. Jordan, Leland Stanford, Jr., University, Stanford University, Cal.

Botany, B. T. Galloway, U. S. Department of Agriculture, Washington, D. C.

Anthropology, J. Walter Fewkes, Bureau of American Ethnology, Washington, D. C.

Social and Economic Science, John Hyde, U. S. Department of Agriculture, Washington, D. C.

Physiology and Experimental Medicine (this new section will be organized at the Denver meeting).

Professor D. B. Brace has given out the following list of papers for the joint meeting of the American Physical Society and the American Association for the Advancement of Science:

"Note on the Transmission of Radiation by Thin Films of Asphalt," Professor E. L. Nichols, Cornell University.

"The Visible and Infra-Red Absorption Spectrum of Iodine in Solution," Professor E. L. Nichols and W. W. Coblentz, of Cornell University.

"Results of the Recent Magnetic Work of the United States Coast and Geodetic Survey," Dr. L. A. Bauer, Washington, D. C.

"The Physical Decomposition of the Earth's Permanent Magnetic Field," Dr. L. A. Bauer, of Washington, D. C.

"Discharge of Electrification by Glowing Platinum and Velocity of the Ions," Professor E. Rutherford, of the McGill University in Montreal.

"The Absorption Spectrum of Colloid Ferric Hydrate Solutions," Professor B. E. Moore, of the University of Nebraska.

"Study of Refractions and Dispersion of Dilute Aqueous Solutions," Professor Moore.

"On the Calorimetric Properties of the Ferro-Magnetic Substances, with Special Reference to Nickel-Steel," Professor B. V. Hill, of the University of Berlin.

"Note on Strains in Very Dilute Solutions of Gelatine," Professor Hill.

"On Electrostriction," Professor Z. S. Shearer, of Cornell University.

"The Dissolution of Energy in the Spectrum of the Acetylene Flame," George W. Stewart, of Ithaca, N. Y.

"The Visible Spectrum of the Incandescent Lamp at Various Temperatures," Ernest Blaker, Ithaca, N. Y.

"The Heat of Combustion in Acetylene," H. A. Rand, of Ithaca, N. Y.

"The Radiant Efficiency of Vacuum Tubes," Edward E. Roberts, of Ithaca, N. Y.

"The Fall of Temperature Through a Wedge-Shaped Wall of Glass," Albert Ball, of Ithaca, N. Y.

"Notes on the Supposed Elongation of a Dielectric in an Electrostatic Field," Professor L. T. Moore, of the University of Cincinnati.

"On the Cavendish Experiment and the Law of Inverse Squares in Electrostatics," Professor S. J. Barrett, of the Stanford University.

"On Gauss's Flux Theorem," Professor Barnett.

"The Diminution of the Potential Difference Between the Electrodes of a Vacuum Tube Produced by a Magnetic Field," Dr. John Almy, of the University of Nebraska.

"The Discharge Current from a Surface of Large Curvature," Dr. Almy.

"Experiments on a New Form of Standard High Electrical Resistance," H. C. Parker, of Columbia University.

"Variation of Contact Resistance with Change of Electro-motive Force," Professor Parker.

"On the Demagnetization of a Discharge in Iron when Electromagnetically Compensated," Zeno Crook, of Lincoln, Neb.

"On the Forces Produced on Adjacent Spherical Surfaces by the Flux of a Viscous Fluid," S. R. Cook, of Lincoln, Neb.

"On the Determination of Dispersion by Means of Channeled Spectra with the Concave Grafting," P. J. Autes, of the University of Nebraska.

"The Absorption and Dispersion of Fuchsine," W. B. Cartmel, of the University of Nebraska.

"On Conditions Controlling the Drop of Potential at the Electrodes in Vacuum Tube Discharge," Professor C. S. Skinner, of the University of Nebraska.

"The Influence of Temperature Upon the Photo-Electric Effect," Professor John Zeleney, of the University of Minnesota.

"On the Resolution of the Faraday Effect in the Case of Liquids," Professor D. B. Brace, of the University of Nebraska.

"On the New Method of Determining the Curve of Luminosity by Homogeneous Comparisons," Professor Brace.

High-Speed Electric Suburban Road in Westchester County.

A hearing, scheduled to be held by the State Railroad Commission of New York, in New York city, August 5, on the subject of an application of the New York & Port Chester Railroad Company for permission to build a four-track electric railroad from Manhattan to Port Chester, has been postponed until September 9. It is believed that at that time the matter will be taken up fully and that action of some sort may be expected. It is the plan of the projectors to build a high-speed service four-track railway connecting the towns of Port Morris, Mount Vernon, Pelham Manor, Larchmont, Orienta, Mamaroneck, Rye and Port Chester with New York city. Close connection will be made with the rapid-transit subways on the east side, and it is expected that suburban passengers may be handled with great rapidity to these points. The representatives of various railroad companies having lines in the same territory were present at the postponed meeting.

Capillary-Electrical Phenomena.

The following is from a short abstract of a paper by Mr. W. Palmaer in the *Journal* of the Chemical Society for July. It contains a discussion of the theories of Helmholtz, Warburg and Nernst regarding electro-capillary phenomena. The author considers that there is no evidence to support Helmholtz's view of the influence of time or to support Warburg's idea of the capability of mercury to cause a condensation of the solution at its surface. Further, the explanation of Warburg would necessitate an inconceivably high concentration of the salt in the layers of solution contiguous to the mercury. The Nernst theory explains most of the facts without the necessity of any new hypothesis, both in regard to the phenomena obtained with pure mercury and with amalgams, whereas Warburg's theory necessitates contradictory suppositions with different amalgams.

The Japanese statistical report, entitled "Annual Return of the Foreign Trade of the Empire of Japan," shows the remarkable growth in the exports of the United States to Japan. The imports from the United States have grown from 6,000,000 yen, in 1893, to over 60,000,000 yen, in 1900, and that the United States, which stood sixth in rank in the list of countries from which Japan drew her imports in 1893, is now second in the list, being only exceeded by Great Britain.

Excellent Doctrine.

[From the New York Times.]

The ELECTRICAL REVIEW advises the would-be engineer to acquire, as the foundation of his professional career, something very much like a college education. It tells him to learn German and French, in order that he may be able to take in at first hand all that is best in the scientific literature that interests him, and it advises especially a much more extensive study of the higher mathematics than is favored in some of the technical schools. A man who knows a great deal about electricity and nothing about anything else is declared to be not nearly so valuable or so likely to succeed as one who knows half as much about electricity, but has a good general education and the degree of culture that goes with it. "In the United States we need at present," concludes the article, "two kinds of electrical men—skilled and thoroughly trained artisans, and men of high scientific attainments combined with wide general culture. From the first class we may expect practical work of the utmost value, and from the second we may look for discovery and invention, research and calculation, that will form the basis for the labors of ensuing generations of artisans. For the half-educated electrical engineer there is practically no place at all." All this is excellent doctrine, not limited in application to electrical engineering, and, coming from the source it does, sufficiently answers the eminent but misguided individuals who have of late been advising young men to learn nothing not directly bearing on the work they intended to do.

A New Type of Inductor Alternator.

The inductor type of alternating-current generator is one which is rapidly attaining great popularity on account of the simplicity of the machine and its great mechanical strength. Since these machines can be made without moving wire they possess many advantages of durability, the insulation being exposed to no mechanical strain during the operation of the machine and on this account, perhaps, a large number of alternators designed to generate very high potentials have been made on the inductor plan.

In the accompanying illustrations is shown a new type of inductor alternator manufactured by the Electric Machinery Company, of Minneapolis, Minn. Fig. 1 shows a complete machine. Fig. 2 shows the upper part of the stationary armature lifted, exposing the inductor, and Fig. 3 shows the inductor itself. The latter is composed of cast steel with laminated polar projections and is energized by the stationary coil shown in Fig. 4, which surrounds its smaller end. The armature coils are carried on a rigid structure and are easily capable of being insulated for pressures up to and surpassing 10,000 volts. The lower half of the casting, forming the ring of the machine and carrying the armature, is made in a single piece, carrying the bearings in machines up to 180 kilowatts capacity. Larger machines have three bearings, the third bearing being outside of the pulley. The base is made very heavy and stiff in order to retain the bearings on a true level. For convenience in shipment the larger units are subdivided, and by means of a comprehensive system of dowel pins can be set up with great accuracy at any point.

The armature body is built up of very thin soft sheet steel which is carefully annealed after punching into shape and is served on both sides with an insulating paint. A series of recesses between the cast frame and the outer circuits of the armature admits a free circulation of air entirely around the latter, but these recesses being entirely internal to the frame the exterior of the latter is retained smooth and symmetrical without unsightly ventilating openings. The armature coils are of plain oblong type, machine wound, this simple form of coil being thought to reduce the hazards of winding to a minimum. The coils are saturated with an insulating compound and thoroughly taped and coated outside with an oil and water-proof covering. All the coils are laid in semi-flexible mica troughs lying in the slots of the armature, these being tested to 6,000 volts breakdown for the lower voltage machines, and to 15,000 volts for the high voltage machines. The slot cover, which closes up the coil slot and keeps the coils in place, is perforated so as to allow the inductor to circulate a current of air through the machine while it is running.

The field-coil case consists of two ring castings, spaced apart with rods of insu-

FIG. 1.—A NEW TYPE OF INDUCTOR ALTERNATOR.

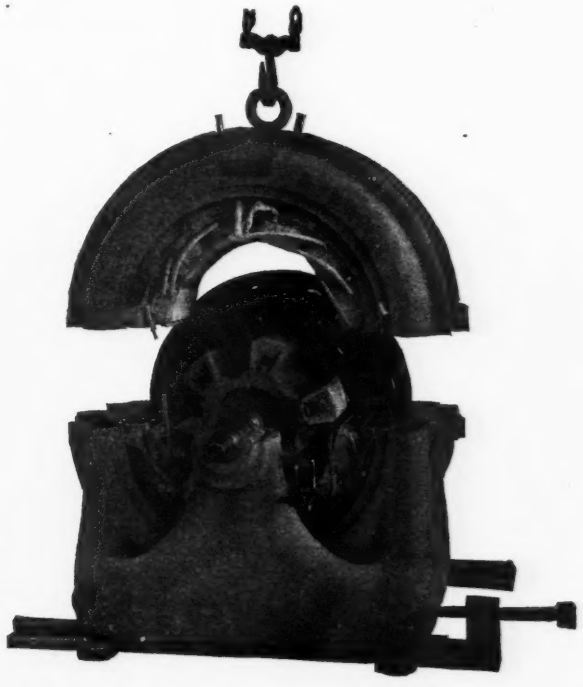


FIG. 2.—UPPER HALF OF STATIONARY ARMATURE REMOVED.

lating material. The sides are lined with narrow strips of insulating material and are cut away except where backing is required for the insulating strips. The wire being wound over the rods and in contact

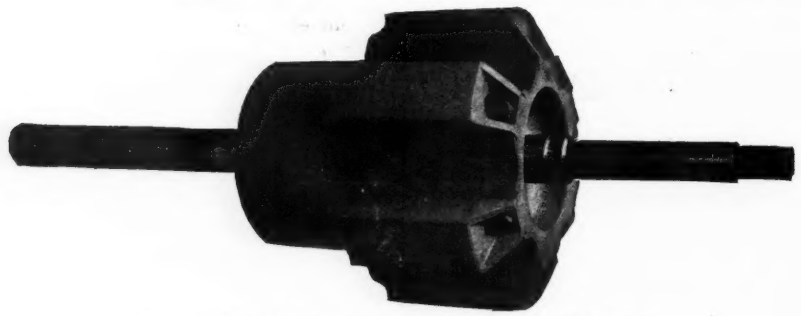


FIG. 3.—THE INDUCTOR OR ROTATING PART OF MACHINE.

only with them and the strips is in a skeleton case, leaving the greater part of the winding fully exposed to the air so as to insure the highest degree of ventilation.

On these machines the bearings are of the self-aligning, self-oiling type, babbitt lined, and are adjustable both vertically and horizontally. On account of the structure of the machine there is no end-thrust, and the shaft plays easily in its bearings. These machines are at present wound for 133 or 60 cycles per second, single or two-phase, and are built in sizes of from 25 to 250 kilowatts. The standard machines are wound for 1,100 or 2,200 volts primary, and machines of either voltage may be provided with a subsidiary armature winding giving a standard voltage of 110 or 220 volts for local lighting. This arrangement saves the cost of transformers for local lighting and has many other advantages.

Nantucket to Have Wireless Telegraph Station.

Commander J. S. Kelly, U. S. N., and Mr. W. W. Bradfield arrived at Nantucket, Mass., August 2, with instruments and equipment for the wireless telegraph station at Siasconset. Work will be begun immediately and rushed to completion. As soon as the work is finished, Mr. Bradfield and an assistant will leave on one of the lighthouse steamboats for the South Shoal Lightship. It is expected that the system will be in operation in a few days.

Wireless Telegraphy to Cross Lake Michigan.

It has been announced by W. S. Mercereau, superintendent of the Père Marquette system, of Milwaukee, Wis., that his company will soon install wireless telegraphy between Manitowoc and Sudington, across 156 miles of open water. This company expects later on to equip all of its steamboats with the system. It is also announced that the Northwestern Wireless Telegraph Company, of Chicago, is moving ahead on its plan to connect Milwaukee with Chicago by commercial wireless telegraph.

The Pan-American Exposition Complete.

Mr. Mark Bennitt, superintendent of the press department of the Pan-American Exposition, has sent out the official announcement that the exposition is now completed in every detail. It is gratifying to know, also, that the success of the exposition is assured. Electric lighting, such as has never been seen before, furnishes the *clou*—that something which the visitor carries away in his memory as the feature of features.

Mr. Bennitt and his efficient staff are to be congratulated upon the extraordinary success they have achieved in keeping the features of the exposition before the public. No department of publicity of any former exposition has been better managed, and much of the success of the enterprise is due to the efforts of the press department.

German Technical Bureau Proposed.

It is understood that a federal bureau of technics is to be established in Germany. The executive committee having charge of the preliminary steps in the matter consists, it is said, of members of the leading chemical works, the Technical Association of Germany, the Association of German Engineers, the Central Bureau for Scientific Investigation and others. The scheme is also supported by several well-known electrical firms in Germany.

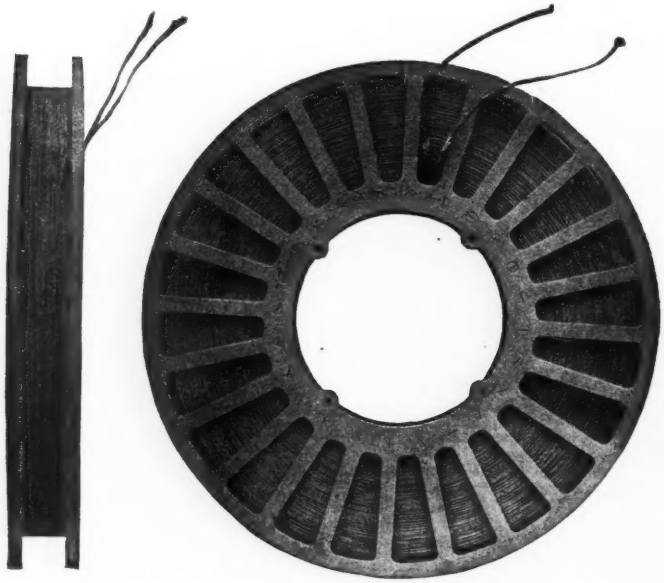


FIG. 4.—THE STATIONARY FIELD COIL—EDGE AND FACE VIEWS.

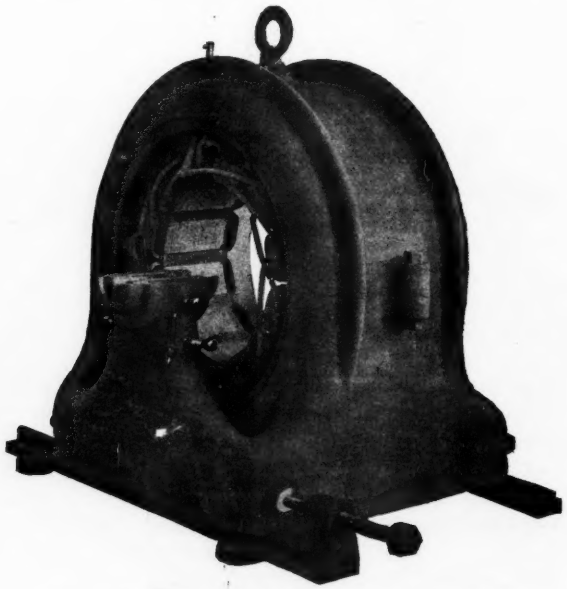


FIG. 5.—THE STATIONARY ARMATURE COMPLETE.

By boiling linseed oil and ordinary glue it can be made into a glue which resists damp. One pound of melted glue in two quarts of skimmed milk, four ounces of shellac, and one ounce of borax boiled in a little water and concentrated by heating to a paste also make an excellent glue for resisting the damp.

Current Electrical News

COMMERCIAL NEWS

DOMESTIC AND EXPORT

The electric light station at Baldwinsville, N. Y., has been damaged by fire to the extent of several hundred dollars. The fire was due to one of the large dynamos being short-circuited, which set fire to the building.

Messrs. Palmer and Olsen, electrical contractors of New York city, have made an assignment to James E. Lane. They have been in business since January, 1900. The liabilities of the firm are about $2,000 and its actual assets $6,000.

The United States Consul at Barcelona, Spain, reports that a really wide opportunity in that country is offered to exporters. A firm foothold has already been obtained by such articles as electrical apparatus, typewriters and general machinery.

Mr. Henry Vice, who does a large contracting business in Havana, Cuba, and represents Cuban interests in a number of American machinery firms, is now in the United States with a view to placing contracts for a large amount of machinery. He is at present in the West, but expects soon to be in New York.

According to the present arrangement a party of prominent French electrical engineers will soon arrive in New York for the purpose of inquiring into the best traction and light methods and securing data as to the organization prevailing in the large works which manufacture various electrical equipments. They will also visit Philadelphia, Washington, Buffalo and Chicago.

The Westinghouse Electric and Manufacturing Company has inaugurated, at its plant in East Pittsburgh, a bonus system based on the net earnings of the company. The bonus is distributed among the assistant superintendents, general foremen, foremen and sub-foremen, and if successful will be extended by the company to take in the skilled workmen of the plant.

The Richmond Light, Heat and Power Company, of Richmond, Ind., has brought suit against the city to restrain it from expending further money in the construction of its municipal light plant. The company alleges that it has suffered damages to the extent of $10,000 as a result of the city's action thus far in beginning the construction of a municipal plant. The city has a contract with the light, heat and power company to furnish lights for its streets which does not expire until 1904. The result will be watched with great interest.

It has been proven by events that the tax law drawn by the legislature of the island of Porto Rico will provide ample means for the island's requirements. Nevertheless, scarcely an instance can be cited where any considerable amount of American capital has been invested in Porto Rican securities. Numerous promoters and capitalists have visited the island and then have gone away never to be heard from again. One large telephone enterprise, however, is under way. Mr. F. H. Dexter has sailed for the United States with a signed franchise issued to a telephone company empowering it to connect the local systems of San Juan, Ponce and Mayaguez by long-distance lines. The telephone company, according to the terms of its license, is to pay the insular government for its right a royalty of 12½ per cent of its gross receipts in addition to taxation.

ELECTRIC LIGHTING

It is stated that the Port Deposit Electric Company, of Port Deposit, Md., will improve its plant.

An electric light plant in connection with the waterworks is being considered in Sharon, Tenn.

Bids will be received until August 16 by the Board of Works of Indianapolis, Ind., for a new lighting plant.

In Nashville, Tenn., a charter has been granted to an electric light company to install a plant in the city.

The Sterling Electrical Manufacturing Company will build its new plant at Warren, Ohio, at a cost of $50,000.

It is reported that E. B. Veitzell, of Frankfort, Ky., is arranging to build a new elecstall a plant in the city.

The city auditor of Park River, N. D., is asking for bids until August 12 for an electric light plant and waterworks.

An electric lighting plant, which has been under discussion for several years, will soon be established in Cedarsburg, Wis.

News comes from Cooperstown, N. D., that W. R. Brueske, of Wimbledon, N. D., is preparing to build an electric light plant there.

A large amount of electric machinery is being received in Reading, Cal., to be used in mining and electrical pursuits there.

Messrs. Loweth and Wolf, of St. Paul, Minn., ask for bids until October 7 for installing an electric light plant at Brookings, S. D.

It is reported that a new electric light plant will soon be built in Mansfield, Mass. Mr. Robert Rogerson is one of the parties interested.

The council of Granite City, Mo., has granted a franchise to E. W. Hilker, Walter Roman and August Miller to build a light and power plant.

At Doylestown, Ohio, Charles F. Sturtevant, engineer, will receive bids until August 12 for constructing an electric light plant to cost about $9,000.

Good progress is being made in excavating the trenches for the foundations of the new plant for the Consumers' Lighting Company at Middletown, N. Y.

It is reported that the Berlin Electric Light Company, of New Hampshire, has nearly completed the foundation for its new auxiliary power-house.

The water-power rights at the Hopewell Mills, of West Virginia, have been purchased by C. H. Emig, of Hanover, Pa. It is proposed to develop the power of its waterfalls.

The first shipment of electrical machinery for the Keswick Electric Power Company, of California, has arrived, and two large generators are on the way from the manufacturers.

The Merchants' Light Company, of Salt Lake City, Utah, is making plans to build an electric light plant to cost $50,000. Mr. H. C. Edwards is one of the parties interested.

A contract for building a municipal lighting plant in St. Joseph, Mich., has been awarded to the Fort Wayne Construction Company. The construction will begin immediately.

The New Jersey Light and Power Company has prepared plans and specifications for the erection of a $150,000 power-house in Kearney, N. J. William Hanna is president of the company.

A large power plant will be built at Sheldon Springs, Vt., by the St. Albans Electric Light and Power Company, which has recently been reorganized. Mr. J. F. Kelley, of Pittsfield, Mass., is president.

Grantsburg, Wis., is soon to have a $15,000 electric light plant which is to be built by the Grantsburg Electric Light and Power Company. Mr. A. Z. Drew and Mr. A. P. Nelson are interested in the company.

A new electric light plant is being installed by the Des Moines Brass and Electric Works, of Des Moines, Iowa. This plant is to be strictly modern in every respect. It will be completed and in operation by September 1.

Five thousand dollars has been deposited by the Consumers' Electric Company as a guarantee that it will, within a year, supply 10,000 incandescent lights to the city of Ottawa, Ontario. Mr. J. W. McRae is one of the parties interested.

The contract for erecting the power-house of the Western Illinois State Normal Institute at Galesburg, Ill., has been let to the Tri-City Construction Company for $9,000 and to the Peoria Heating Company for the heating system for $19,000.

The Union Electric Light and Power Company, of Unionville, Ct., has commenced work on its new plant. Mr. A. J. Slater has the contract for the mason work. It is intended to have a combination incandescent and arc-light system.

News comes that the Sierra Electric Light, Power and Water Company, of Sonora, Cal., proposes to construct 18 miles of ditching on the north fork of the Tuolumne River and supply Carter's and the adjacent mines with water facilities. C. H. Carter is president of the concern.

The people of Grantsburg, Wis., have decided to grant a franchise to the Grantsburg Electric Light and Power Company. Work will be begun at once on a dam across Wood River to furnish the company with water. By the terms of the franchise the plant must be in operation by January 1, 1902.

Nine carloads of electrical machinery have been delivered to the McCloud Electric Power Company, of California, and 60 tons of copper wire have been contracted for. This machinery comes from the Bullock Electric Manufacturing Company, of Cincinnati, Ohio, and the Wagner Electric Manufacturing Company, of St. Louis, Mo.

The Birmingham Railway, Light and Power Company, of Birmingham, Ala., has authorized an issue of $6,000,000 worth of bonds on the property recently acquired, $2,000,000 of which will be expended upon improvements throughout the system. A new car barn to replace the one burned several months ago will be constructed at once.

Owing to the breaking of a pulley flywheel in the plant of the Wichita Light and Gas Company, of Wichita, Kan., July 22, the electric fan and power service of the company was considerably interrupted. Considerable damage was done to adjacent machinery, but fortunately no one was near enough to the bursting wheel at the time to be injured, which was peculiarly fortunate.

ELECTRIC RAILWAYS

Rumor has it that a trolley line will soon be built from Hellertown to Riegelsville, Pa.

A Lowell, Mass., syndicate is preparing to build an electric road from Natick to Sherborn, Mass.

The Waterloo-Denver electric line of Missouri will commence the work of construction very soon.

A trolley road from Meyersdale to Salisbury, Pa., has been chartered and some of the franchises obtained.

The county commissioners of Ohio are considering a franchise for an electric line between Newport and St. Marys.

The right of way for an electric railway between New Cumberland and Lewisburg, Pa., is being secured from the land owners.

A large force of men is at work grading the line of the Birmingham Light and Power Company between Ensley and Birmingham, Ala.

The board of trustees of the village of Canastota, N. Y., has granted a franchise to the Canastota & Morrisville Railway Company.

Applications for franchises for trolley lines in Easton, Pa., have been asked for by C. S. Hemingway, B. Frank Miller and others.

Incorporation papers were made out for the Sandusky, Clyde, Tiffin & Southern Railway Company, with a capital stock of $10,000.

The United Railways and Electric Company has awarded the contract for building new lines in Baltimore, Md., to Thomas Newhall & Company.

Bids for the trolley line from Hagerstown to Boonesboro, Md., have just been opened, but the contract for the construction work has not yet been let.

The ordinance committee of Bay City, Mich., has reported favorably upon the franchise of the Detroit, Pontiac, Lapeer & Northern electric road.

The Schuylkill Valley Traction Company, of Pennsylvania, has completed its extension to Trappe, and cars will be running over it regularly in a few days.

A franchise at Oconto has been granted for the building of the electric line from Green Bay to Menomonie, Wis., and rights of way are now being secured.

The Ludington & Northern Railroad has completed its extension to Hamblin Lake. Its final realization is due to the energetic efforts of the Hon. J. S. Stearns.

The People's Railway Company, of Delaware, is having the rails for its unfinished lines delivered. The construction of several of its lines is already under way.

The Camden, Gloucester & Woodbury Railway Company has applied to the National Park Association for right of way to extend its lines to Paulsboro, N. J.

The preliminary organization for a new electric line from Sandusky to Tiffin, Ohio, has been made. J. C. Parker is the president and F. B. Zollinger the treasurer.

News comes from Sanbornville, N. H., that capitalists are looking over the route for a new electric railroad to run from Union, N. H., to Springvale, Me.

The Utica Suburban Railway Company, of New York, has applied to Highway Commissioner Thomas H. Newman for permission to construct additions to its lines.

The contract for the construction of an electric road between Seattle and Tacoma, Wash., has been let to Hale & Smith, of Portland. The contract price is not given out.

The site for the power-house of the Toledo, Bowling Green & Southern Traction Company, of Ohio, has been purchased. The building and plant together will cost $300,000.

The right of way for the proposed Dundee & Bradford electric railway of New York has all been secured according to report. It is expected the work of construction will soon begin.

The United Railways and Electric Company, of Baltimore, Md., has issued inquisitions against land owners along the line of its proposed extension from Dunkirk to Sparrows Point.

The Springfield & St. Louis Electric Company, which proposes to build a line from Springfield, Ill., to St. Louis, has just elected its officers. E. H. Little, of Buffalo, N. Y., is president of the concern.

Application has been made to the Wallawalla city council by O. R. Ballou for an electric road through Milton, Ore. It is understood that the material for the plant will be purchased in the East.

It is stated that the work of constructing the trolley line between Williamsport and Autes Fort, Pa., will be begun within two weeks. C. B. McCullough has been elected general manager of the company.

A complete system of electric street cars will soon be constructed in El Paso, Tex., by the Goodrich company. This information has just been given out by Mr. Leigh Clark, the attorney for the company.

The Ambler & Jenkintown Street Railway Company, of Pennsylvania, has its engineer engaged in surveying a line from Ambler to Jenkintown. This is one of the companies incorporated by the Sweigard Syndicate.

The state railroad commissioners have granted a franchise to the Genesee and Orleans Railroad to build a trolley road from Batavia to Point Breeze, N. Y. Charles E. Hart, of Albion, is the president of the company.

A plan is under way for extending the four-mile electric railway which connects Lima and Honeoye Falls, N. Y. Power can be secured at the latter place, and the scheme is to extend the road from Lima to Rochester.

Vandergrift Brothers have received the contract from the Wilmington & West Chester Electric Railway Company to build its line from Brandywine Springs to Unionville, Pa. The work will commence by September 1.

The Chestnut Hill street car line of Richmond, Va., will extend its lines to Chelsea Hill and will inaugurate a 10-minute schedule. Mr. Fritz Sitterding, who recently bought this line, is planning extensive improvements.

The London, Aylmer & North Shore Electric Railway Company, of Aylmer, Ontario, has secured franchises for 50 years from all municipalities along the route, and it is said that work will very shortly begin on the construction.

Stone & Webster have their consulting engineer, Charles T. Maine, in Columbus, Ga., looking over the system with a view to building another line. This line will extend to the new cotton mills on the Highlands north of the city.

The city council of Charlotte, Mich., has granted a franchise to Robert Gordon, giving him the power to operate a street railway through Charlotte. By the terms of the franchise the line must be in operation within two years.

A number of citizens of Lexington, Mo., who are interested in the building of a line from Kansas City to Lexington, were in Leavenworth to inspect the electric tramways there. It is expected that this railway will soon be begun.

News comes from Michigan that the Indiana street railway has commenced the distribution of material for the building of an electric street railway between Niles, Mich., and South Bend, Ind. Work will be begun in a few days.

The Thornapple Electric Company, of Michigan, expects to have its railway plant in operation within 90 days. Although the floods following the recent heavy rains have done considerable damage the big dam at Lebarge is being rapidly completed.

It is stated that good progress is being made in the preparation for the building of the electric road between Washington and Canonsburg, Pa. The surveying has now been completed and the work of building the road will commence in the fall.

The common council of Albany, N. Y., is considering an ordinance providing for the sale of a franchise for the construction of a street railway over certain avenues in that city, and also an ordinance providing for a franchise for telephone privileges.

A franchise for a line between Massillon and Navarre, Ohio, has been granted to the Canton & Massillon Railway Company by the county commissioners. The tracks of the new line have already been laid from Massillon to within a mile or so of Navarre.

The Port Jervis Electric Light, Power and Gas Company, of New York, has purchased the Port Jervis electric street railroad, Port Jervis electric light and power and Port Jervis gas plants. Ralph H. Beach, of New York, is the president of the new company.

Cars will be running regularly over the new line of the York Traction Company, of Pennsylvania, from York to Dallastown on and after July 27. An imposing public celebration will be held in Dallastown to mark the event, at a date to be determined later.

Rumor has it that the United Traction Company, of Pennsylvania, of which John A. Riggs is president, is negotiating for the trolley interests in Reading, Pa., controlled by the Shepp Brothers, of Philadelphia. This rumor, however, is denied by President Riggs.

The New York State Board of Railroad Commissioners has granted the application of the Monticello, Fallsburg & White Lake Railway Company for authority to construct its lines. The road will be 16½ miles long and will be operated by electricity.

The Supreme Court of New York has served an injunction on W. W. Worden, of the Saratoga Traction Company, restraining him from further trespassing upon the lands of G. W. Morton. The injunction is returnable before Chief Justice J. W. Houton on August 10.

Work will soon commence upon the new trolley line for the Tamaqua & Sansford Street Railway Company in Pennsylvania, between Sansford and Mauch Chunk. Upon the completion of this section of eight miles Tamaqua and Sansford will be connected by trolley.

The construction of the connecting links of the Philadelphia & Lehigh Valley Traction Company's trolley line between Allentown and Philauelphia, Pa., is being pushed along rapidly, the contractors having a large force of men at work between North Wales and Ambler.

Mr. F. S. Coolidge has been elected president of the Mount Wachusett, Mass., Street Railway Company by its incorporators. It is proposed to build an electric line up the mountain as far as the grade will permit and construct a cable for the balance of the way to the top.

News comes from Iowa that the electric line between Guttenburg and Garnellsville will be running by October 1. Thirty-five thousand dollars out of the $100,000 capital stock has been subscribed. A. Brandt is the president of the company, which has just been organized.

A. S. Ward, of Chicago, will superintend the construction of the railway from Warehouse Point, Ct., to the terminus of the Hartford Street Railway. A new power-house will be built in Warehouse Point. It will be equipped with the most modern engines and dynamos.

Dr. R. C. Light and Mr. William Bossom have left Indianapolis, Ind., for New York, where they expect to complete arrangements with eastern capitalists for the building of the Indianapolis & Logansport Interurban Railway. Dr. Light has purchased the stock of George J. Marrott.

The Buffalo, Niagara Falls & Rochester Railway Company has executed a mortgage to Sutro Brothers, of New York, whereby the company secures funds with which to construct the road. The amount of the mortgage is $3,500,000, and it covers the entire assets of the road.

It is reported that a syndicate will construct an electric railway between Troy and Hoosick Falls, N. Y., along the old stone road running between these cities. It is proposed to make the road a freight as well as a passenger line, and cars will be run at a speed of 35 miles an hour.

The directors of the Indianapolis, Morristown & Bushville electric line have announced that the contract for the construction of the road has been signed. The name of the contracting firm has not yet been made public. The road will cost in the neighborhood of $1,500,000.

It is now an assured fact that Grand Rapids, Mich., and Stevens Point will soon be connected by an electric railway. It is expected that the railway will eventually extend the whole length of the Wisconsin River Valley. The water power of the valley will be utilized as a motive power.

The Watertown & Carthage Traction Company has received permission from the highway commissioners of Wilna and Champion, N. Y., to lay tracks in the highways of the towns mentioned. It is the intention of the company to extend the road to the village of Croghan, and thence to Lowville.

S. L. Nelson, general manager of the Fort Wayne (Ind.) & Southwestern Traction Company, has just returned from a trip over the proposed extension of the road from Huntington to Marion, Ind., and he reports that good progress is being made upon the construction of the road.

The Buffalo & Williamsburg Railroad Company, which is operating an electric road now from the Pan-American city to Williamsburg, desires to extend the road from the present terminus to Rochester, and with that end in view will ask the Batavia village council to grant it the right of way.

Judge John F. Kinney, of Rochester, N. Y., has filed an application with the state board of railroad commissioners to construct a trolley line between Lyons and Sardous, N. Y. The road will be 11 miles long and will cross private properties, connecting at Lyons with the New York Central Railway.

A stubborn fight is being made at Greensburg, Pa., for franchises by the Westmoreland, Allegheny & Westmoreland Electric Heat and Power Company, composed of Fort Wayne, Ind., and Pittsburgh capitalists. Although it has been turned down by the local councils further attempts will be made.

The Colonial Trust Company, of Philadelphia, has furnished the money needed to complete the Erie northeast trolley line of Erie, Pa. Vandergrift & Company, the builders, executed a mortgage to the trust company for $350,000 last week. The line, which is 16 miles in length, will be completed at once.

The Lehigh Valley Traction Company's system has awarded the contract to build its Allentown and Quakertown branch to Hugh E. Crilly, of Allentown, Pa. He will begin operations at once, since most of the material is already upon the ground. The line is to be completed and in operation by September 1.

The highway commissioners of Utica, N. Y., are to give a public hearing upon the petition of the Utica Suburban Railway Company for the right of way through Utica over the proposed electric railroad extension from New Hartford to Clinton. It is expected that the petition will be granted.

It is reported that the Everett-Moore Syndicate, of Cleveland, Ohio, has now secured the control, or bought outright, a system of electric roads extending from Pittsburgh to Detroit. The Vanderbilts are said to be interested in this deal. Mr. Everett says: "We propose to work in harmony with the existing steam lines."

A franchise has been granted to the Genesee & Orleans Railway Company to build an electric line from Batavia to Oak Orchard, N. Y. The promoters of the scheme are Rochester capitalists. The capital stock of the company is $350,000. The road will run through the towns of Elba, Batavia, Barre, Gaines and Carleton.

The Saratoga Traction Company has been compelled by the New York State Railway Commission to continue the abandoned branch of its road from Moore Station, Saratoga Lake, to a point about two miles distant. This was the result of a complaint of James H. Riley against the company.

The Connecticut courts have granted permission to the Connecticut Railway and Lighting Company to extend its lines from Ansonia to Seymour, and also from Waterbury to Watertown. Work will be begun upon these extensions as soon as new power machinery and construction material arrive.

Work has been stopped for a time upon the new Lansing, St. Johns & St. Louis, Mo., electric line on account of the opposition of the St. Johns common council. The company wishes to enter the city by a different route from the one provided in the franchise. It is reported that the council will soon accede to the desires of the company.

W. H. Burghart, of Salem, Ore., has presented to the county court of Marion County a petition asking for the grant of a franchise for the operation of an electric railway from Salem to Silverton, a distance of 15 miles. It is desired that the road be permitted to build along the county highways. The road will be known as the Oregon City Southern Railway Company.

It is very doubtful, according to those in position to know, if the new Boland electric line from Ann Arbor to Detroit, Mich., *via* Plymouth, can be completed by January 1 as originally contemplated. Although the material is nearly all on the ground, it seems utterly impossible to obtain men and teams sufficient to make any kind of a start, as they are engaged in work on the Pere Marquette.

L. H. Austin, of Toledo, and John O. Zabel, of Petersburg, were in Milan, Mich., July 17, and conferred with the business men and some of the members of the Milan township board relative to securing a franchise through that place. The franchises and right of way of the proposed electric railway from Toledo to Ypsilanti, except from Milan to Dundee, it is understood have been secured.

At a meeting of the Amsterdam Street Railroad Company, of New York, it was voted to increase the capital stock from $250,000 to $1,000,000. This increase was made necessary by the extension which the company is planning. President Hees announced that the contractors' specifications for the building of the new roads would be issued to prospective bidders on the work inside of 10 days.

The Deer Park Electric Company, of Port Jervis, N. Y., has been sold to the New York syndicate, which a few weeks ago purchased the properties of the Port Jervis Street Railway Company, Port Jervis Gas Company and the Port Jervis Light and Power Company. The four plants have been consolidated under one management, and will be known as the Port Jervis Electric Light, Power and Gas Company.

The affairs of the Lehigh Valley Traction Company are attracting considerable attention owing to the fact that its first mortgage, four per cent bonds to the amount of $3,000,000 have been listed on the Philadelphia Stock Exchange. This company is well known as the main trolley system of the lines controlled in this state by the syndicate which was headed by the late A. L. Johnson.

The Metropolitan Street Railway Company, of New York, has begun the work of building the Kingsbridge road underground trolley line. The first section of the work begins at Kingsbridge road and Amsterdam avenue. The extension will connect with the Amsterdam avenue line at 162d street. This makes possible a line of through trolley cars from the Battery over the Sixth and Amsterdam avenue routes of the Metropolitan Street Railway Company to Yonkers, N. Y.

Arrangements have been completed with eastern and western capitalists by the Louisville, Anchorage & Powee Valley Electric Company to issue $18,000,000 worth of 40-year five-per-cent gold bonds. The purpose of these bonds is to cover the greater part of Kentucky with a system of interurban electric railways. The line running from Louisville to Powee Valley is the trunk from which branches will be run through the Blue Grass section of the state extending as far as Stanford and Richmond.

The Hartford & Springfield, Mass., Street Railway Company has purchased a piece of land at Warehouse Point upon which it will construct a new brick power-house 100 by 90 feet. The power-house will be equipped with a Hampton-Corliss engine of the latest design, and an electric generator will be put in. One of the boilers will be of 500 horse-power and two of 250 horse-power. A Boston firm will erect the building, and A. L. Ward, of Chicago, will be in charge of the extension from the terminus of the road at Warehouse Point to the East Windsor Hill.

The city of Rochester is the centre of a network of electric roads already in operation or in progress of development. The Rochester, Lockport & Buffalo Railway Company has just been granted a franchise by the State Railroad Commission to build an electric line from Rochester to Buffalo. It is capitalized at $3,500,000. Franchises are asked for by the Genesee & Orleans Company, to build a line from Batavia to Oak Orchard, 27 miles; the Monroe County Belt Line, to run through the villages of Brighton, Fairport, Pittsford, Penfield and Despatch, 20 miles; the Rochester & Eastern Railway Company, to construct a line from Rochester to Geneva, 65 miles; Rochester & Sullivan Traction Company, to build a line from Rochester to Dansville, 78 miles.

ELECTRICAL SECURITIES

The general business situation of the last week may be summed up in the statement that most interests have remained interested spectators of the struggle between the steel manufacturing interests and the labor unions. The pendency of any great industrial conflict has generally a depressing effect, but the final result of the contention between the United States Steel Corporation and its employés has been so far discounted that the general course of the steel stocks and of the market at large has been firm and upward. At this writing there has been no settlement of the matter and things remain very much as they have for the past week. It is believed, however, by those who are best informed, there can be but one end to the situation, which is the triumph of the Steel Corporation and the maintenance of about the same relations in the future that have existed in the past between employers and employés in this important line of business. So far it has not been possible to gauge the effect of the recent favorable weather conditions in the afflicted corn-producing regions of the Middle West or entirely to estimate the amount of damage caused by the protracted drought or the recuperating effect of the recent rains. Under these circumstances the market has been quiet and somewhat dull as will be seen from the figures from the various centres of stock movements given below:

ELECTRICAL SECURITIES FOR WEEK ENDING AUGUST 3.

New York:	Highest.	Lowest.	Closing
Brooklyn R. T....	77½	75½	75¾
Con. Gas.	223	218	222¼
Gen. Elec.....	256	253½	254
Man. Elec.....	119¾	117	117¾
Met. St. Ry.....	169½	166	166
Third Ave. R. R....	...	...	122
Kings Co. Elec....	...	...	197
N.Y. & N.J. Tel. Co. ...		...	170
Telep.,Tel.&Cbl. Co. ...		...	5

Nothing definite is yet known as to what day action may be taken in the matter of increasing the stock of the General Electric Company and distributing the new stock as the dividend. It is rumored that nothing will be done for some little time as yet.

Boston, August 3:	Closing.
Am. Telep. & Tel.....	160
Erie Tel.....	48½
New Eng. Tel.....	135
Mass Elec. pf.....	94
Westing. Mfg. pf.....	79½
Edison Elec.....	260

The directors of the Boston Elevated Railway Company have declared a semi-annual dividend of 3½ per cent. This is an increase from the 4½ to a 7 per cent basis, and its declaration needs the division of one per cent or $100,000 with the State of Massachusetts. A dividend is payable August 15 to stock of record August 3.

The Boston Stock Exchange has listed 62,376 shares of the Cumberland Telephone and Telegraph Company.

The new stock of the American Telephone and Telegraph Company for which payment was due August 1 for an amount equal to one-half of the amount of the shares subscribed for, will not be deliverable until August 15.

The annual meeting of the Boston Electric Light Company will be held August 13.

Philadelphia, August 3:	Closing.
Elec. Co. of Amer.....	7½
Philadelphia Elec.....	5¾
Union Traction.....	26¾
United G. I. Co.....	115
Elec. Stor. Bat. c.....	75
Elec. Stor. Bat. pf.....	75

The stock of the Electric Company of America has recently been purchased in considerable quantities by those who were sellers when it was five points or more higher. It is believed that an upward movement is anticipated.

Chicago, August 3:	Closing.
Chicago Edison Light.....	180
Central Union Telephone.....	45
Chicago Telephone.....	275
Un. Trac.....	16
Un. Trac. pf.....	58
Metropolitan El.....	92

NEW INCORPORATIONS

ROMEO, MICH.—Home Telephone Company. $10,000.

ALTOONA, PA.—Monarch Power Company. $100,000.

HASTINGS, MICH.—Thornapple Electric Company. $100,000.

FRANKFORT, KY.—Jackson & Hazard Telephone Company. $2,025.

GRAND RAPIDS, MICH.—Thornapple Electric Company. $100,000.

HILLSBORO, OHIO—Hillsboro & Ohio River Traction Company. $10,000.

WELLSBORO, PA.—Northern Pennsylvania Telephone Company. $12,500.

CLEVELAND, OHIO—The Cleveland & South Lorain Traction Company. $500,000.

INDIANAPOLIS, IND.—The Valparaiso, Michigan City & Chicago Electric Company. $25,000.

WILMINGTON, DEL.—The Foreign and Domestic Light, Heat and Power Company. $500,000.

RED LION, PA.—The Electric Light Company. Capital stock increased from $8,000 to $20,000.

SALINA, KAN.—The Salina Telephone Company has increased its stock from $25,000 to $50,000.

BLUFFS, ILL.—Illinois Telephone Company has increased its capital stock from $25,000 to $100,000.

CHICAGO, ILL.—Crowdus Automobile Company. Capital stock increased from $100,000 to $150,000.

EAST WASHINGTON, PA.—East Washington Street Railway Company. $24,000. To build a line four miles long.

WEST WASHINGTON, PA.—West Washington Street Railway Company. $18,000. To build a line three miles long.

BENTON, ILL.—Youngblood Stamper Telephone Company. Capital stock increased from $12,000 to $15,000.

MEADOWLANDS, PA.—The North Washington & Meadowlands Street Railway Company. $60,000. To build a line 11 miles long.

ALPINE, TEX.—Alpine-Terlingua Telephone Company. $1,000. Incorporators: A. M. Turney, R. L. Neville and J. C. Bird.

MADISON, MO.—Central Illuminating and Heating Company. $2,500. Incorporators: E. W. Hilker, Walter Ronan and August Miller.

MONETT, MO.—Southwest Missouri Telephone Company. $50,000. Incorporators: Finley P. McGuire, A. J. Singer, A. H. Davis and others.

PLATTSBURG, MO.—Plattsburg Telephone Company. $10,000. Incorporators: J. C. Atchison, F. R. Allen, E. E. Bowlin and others.

KANAKA, N. Y.—The South Howard & Kanaka Telephone Company. $220. Directors: Edward Stewart, Frank Conine and J. C. Borton.

BATTLE CREEK, MICH.—The Interurban Railway Company. $100,000. To construct an electric road from Battle Creek to Cold Water, Mich.

SALT LAKE CITY, UTAH—The Eureka & Palisade Railway. $300,000. Incorporators: M. S. Regna, Oakland, Cal., and J. W. Hellman, Jr., San Francisco, Cal.

TRENTON, N. J.—The Citizens' Light and Power Company. $1,500,000. Incorporators: William A. Jones, Melville A. Carpenter and Joseph B. Short, all of Newark, N. J.

EAST ORANGE, N. J.—Tuolumne Power and Development Company. $250,000. Incorporators: Edward B. Hawkins, A. G. Brown and Herbert S. Murphy.

TEMPLE, TEX.—Belton Light and Power Company. $30,000. Incorporators: F. E. Merrill and W. A. Stewart, of Bell County, and J. T. Smither, of New York.

HAMILTON, ONTARIO—The Electrical Supply Company, Limited. $30,000. To trade in electrical appliances. Incorporators: J. Farrell, George Lowe and S. D. Biggar.

LA CROSSE, WIS.—Nesbonec Electric Company. $100,000. To buy the electric lighting plant and water power at West Salem. E. C. Swarthout, of La Crosse, is the largest stockholder.

BERNARDSVILLE, N. J.—Bernardsville Light, Heat and Power Company. To manufacture electricity. $100,000. Incorporators: Grant B. Schley, C. Ledyard Blair and John A. Dryden.

PETERBORO, ONTARIO—The Ontanabe Power Company. $125,000. To buy, sell and deal in light, heat and power. Incorporators: W. G. Ferguson, Adam Hall, F. J. Jamison, G. S. and R. M. Glover.

BELLAIRE, MICH.—The East Jordan & Southern Railroad Company. Electric railway to be built from East Jordan to Bellaire, Mich. $250,000. Directors: Charles L. Ames, of Oak Park, Ill.; Abel H. Frost and others.

MEYERSDALE, PA.—Meyersdale & Salisbury Railway Company. $36,000. Incorporators: T. N. Nelson, of Chambersburg; George B. Parker, of Pittsburgh; J. S. McFerren, of Pittsburgh, and A. O. Lorentz, of Meyersdale.

GAINESVILLE, GA.—The Gainesville Power and Light Company. $100,000. Stockholders: F. S. Murray, of Chicago, Ill.; J. J. Spaulding, Dalton, Ga.; S. C. Dunlap, Z. F. Castleberry, H. H. Dean, Howard Thompson, E. E. Kimbrough, of Gainesville.

KANSAS CITY, MO.—The Interstate & Leavenworth Railway Company. $500,000. To construct street railways in Kansas City and surrounding places. Incorporators: W. H. Gabriel, of Cleveland, Ohio; Herbert Walcott, of Leavenworth, Kan., and others.

POUGHKEEPSIE, N. Y.—The Consolidated Electric Light, Heat and Power Company. $200,000. Directors: James W. Hinckley, P. Frost Spaulding, Silas Hinckley and John Doheny, of Poughkeepsie, and William K. Roy, of Wappinger's Falls.

CLEVELAND, OHIO—Consolidated Electric Construction Company; $25,000; incorporators: C. C. Bateson, F. C. Werk, Abraham Oppenheimer, A. A. Bemis and P. A. Zizelman. Herr Construction Company; $5,000; incorporators: H. S. Herr, Frank Seither, H. H. Herr, F. S. Turner and G. H. Cowdery.

RICHMOND, IND.—The Eastern Indiana Traction Company. To construct an electric road from Richmond to Portland, a distance of 60 miles. $10,000. Directors: Peter Schwab, Hamilton, Ohio; Henry P. Lane, Elias Folk and Samuel Woodward, Franklin, Ohio, and William H. Puls, West Carrollton, Ohio.

CLEVELAND, OHIO—The Cleveland & South Lorain Traction Company. To build an electric railway from Lakewood, Hamlet to Lorain, passing through Cuyahoga and Lorain counties. $500,000. Incorporators: Charles W. Wells, James H. Burke, Edwin H. Richards, Henry A. Beckerman and Frank W. Norwalk.

TELEPHONE AND TELEGRAPH

A telephone line is being built between Luzerne and Hadley, N. Y.

Five hundred thousand dollars is to be spent in extending the lines of the Suburban Telephone Company, of New Jersey. Mr. Hugh B. Hamil is president of the concern.

A telephone line is to be built from Quanah to Crowell, Tex., and also from Altus to Enid, Okla., by a recently organized company. The work will be begun at once.

A telephone company has been organized by E. A. Fuller, of Ludington, Mich., which has purchased all the lines, telephones, rights, etc., of the Oceana Telephone Company in that country.

The injunction asked for by the heirs of the U. S. Tainter estate to restrain the Western Union Telegraph Company from running its lines into Westchester, Pa., has been refused by the courts.

The Vernon electric light plant, in Vernon, Tex., has been purchased by the Vernon Telephone Company. The two systems will now be united under the name of the Vernon Light and Power Company.

The president of the Northwestern Telephone and Electric Company, Mr. A. B. Ferdinand, has petitioned the board of public works of Milwaukee, Wis., for a permit for a telephone line within the city limits.

The public improvements committee of Dallas, Tex., is considering the petition of Aubrey and Campbell for a telephone franchise in the city of Dallas. The promoters propose to put in an entirely modern system.

Owing to the fact that the cable between Chefoo and Taku has been so seriously interrupted of late the companies have laid a second cable. It is reported also that the Germans have duplicated their lines from Shanghai to Tsintan.

The Chicago Telephone Company has postponed its special meeting from July 31 to August 16. At this meeting means will be devised for the improvement of the service, and for the conduct of the struggle with the Illinois Manufacturers' Association.

It is understood that the directors of the Telephone, Telegraph and Cable Company of America will meet early in August to consider the reorganization of the company. It is planned to raise additional capital and more actively push the business of the company.

Preparations are being made by the People's Telephone Company, of Scranton, Pa., to complete the construction of the lower end of its line from West Pittston to Forty Fort, thus making a complete trunk line on the west side of the river from West Pittston to Plymouth.

The contracts for laying the conduits and underground wires of the Consolidated Telephone Company, of Reading, Pa., have been awarded to I. J. Lerch. They will cover five miles in the centre of the city. The overhead wires will also be strung by the same company. It is stated that Reading will be the headquarters of the new company.

The manager of the Richmond Telephone Company, Colonel C. E. McCluer, is engaged upon the plans and specifications for a central-energy switchboard. This switchboard is to be made by the Kellogg Switchboard and Supply Company, of Chicago. The switchboard and telephones together are to cost at least $35,000.

The Electrical Commission of Baltimore, Md., has refused to grant the request of the Postal Telegraph and Cable Company for an extension of time for the removal of its overhead wires and the construction of a municipal subway. An opportunity for the representatives of the company to appear before the commission to give reasons why the time should be extended has been granted.

Mr. E. C. Fisher has acquired the control of the independent telephone organization of Gowanda, N. Y. It will hereafter be operated under a license from the New York & Pennsylvania Telephone and Telegraph Company. Bell telephones will be substituted for the present telephones. With this the independent lines entering at Gowanda and heretofore operated together with the Gowanda exchange are all closed out.

The Seattle Automatic Telephone Company, of Washington, is installing a very elaborate new plant. Wire and cables to cost $160,000 and large switchboards to cost $125,000 have been ordered. Orders have been placed for between 250,000 and 300,000 linear feet of conduits. At present the company is operating over 400 'phones, and the officials state that not a single complaint has yet been made regarding the service given.

The North Coast Electric Company, in Everett, Wash., will soon have its messenger service in thorough working order with about 100 call-boxes in the city. Instead of the automatic call-boxes in general use the company has a small telephone which rings up the main office automatically when the receiver is taken down. The office is connected with fire and police departments and livery, and the telephone system's superiority over the old method is obvious.

It has been voted by the stockholders of the Central Pennsylvania Telephone and Supply Company and the Pennsylvania Telephone Company, of Harrisburg, Pa., to consolidate their interests and become a portion of the combine formed at Reading to be known as the Consolidated Telephone Companies of Pennsylvania. Richard O'Brien, of Scranton, Pa., will be the general manager of the consolidated companies. Reading will be the headquarters of the combine.

Mr. T. K. Leidyhas has filed articles of amendment to the charter of the Schuykill Valley Telephone Company of New York. The company desires to change its name to the Consolidated Telephone Company of Pennsylvania, and to increase its capital from $400,000 to $4,000,000. The object of increasing its capital is to purchase a number of companies' lines which are to be a part of the new corporation. The new corporation will have its headquarters in Reading, Pa.

The Memphis Telephone Company, of Memphis, Tenn., the independent telephone system of this locality, is now in an excellent state of progression toward completion. The city council of Jackson, Tenn., has granted a franchise to a company for the operation of an independent exchange which will have long-distance connections with the Memphis Telephone Company. Arrangements for the long-distance lines of the Memphis Telephone Company are about to be made with the larger towns in Mississippi.

News from Bozeman, Mont., states that the work on the Pass Creek telephone line has commenced. The poles have been laid along the route for 30 miles. Each farmer must set the poles from the main line to his house, and also string wires and make the connections. It is expected that the line will be in good working order by September 1. The total cost of the line from Bozeman to Pass Creek, including the branches to farm houses and little hamlets along the line, will be in the neighborhood of $1,500. Each farmer buys his own telephone at an expense of $50, and helps in the construction as much as possible.

PERSONAL MENTION

MR. W. L. CANDEE, managing director of the Okonite Company, has returned from a six weeks' visit in Europe.

PROFESSOR PASQUALE VILLARI has been elected president of the Reale Academia dei Lincei, of Rome, to succeed the late Professor Messedaglia.

PROFESSOR WILLIAM ESTY, of the University of Illinois, has been appointed assistant professor of electrical engineering in Lehigh University.

SIR NORMAN LOCKYER, having reached the age of 65 years, will give up his duties as professor of astronomical physics in the Royal College of Science, London, at the end of the present year.

EX-CHIEF DENIS J. SWENIE, of the Chicago Fire Department, has just been made president of the Chicago Fire Appliance Company, which is the Chicago agency for the Monarch Fire Appliance Company, of New York, manufacturer of "Kilfyre."

MR. P. G. GOSSLER, who has recently been elected president of the Canadian Electrical Association, was born in August, 1870, at Lancaster, in Columbia County, Pa. In 1890, when not quite 20 years of age, he graduated from the Pennsylvania State University as mechanical and electrical engineer.

PROFESSOR A. W. RÜCKER has been appointed principal of the University of London. He is professor of physics at the Royal College of Science and secretary of the Royal Society. It is reported that, in consequence of his appointment to his new position, Professor Rücker will resign his secretaryship at the next meeting.

OBITUARY NOTICE

PROFESSOR CHARLES ANTHONY SHOTTE, author of many scientific works, assistant in the Coast and Geodetic Survey, and one of the charter members of the National Academy of Science, has died in Washington, D. C., of Bright's disease. Professor Shotte was born in Manheim, Germany, and was graduated as a civil engineer from the polytechnic school in Karlsruhe in 1847. He came to the United States in 1848 and entered the service of the Coast and Geodetic Survey. Among Professor Shotte's publications are "Meteorological Observations in the Arctic Seas," "Astronomical Observations in the Arctic Seas," and many smaller works. The French Academy of Science conferred a medal upon him for his preeminent researches in the science of terrestrial magnetism a few years ago. At the time of his death he was 75 years old.

AUTOMOBILE NOTES

Motor cars in France will in future be taxed according to their power. In addition to the ordinary tax as four-wheeled carriages they will pay a tax of $1 per horse-power.

The cost of harvesting wheat on the Pacific coast in the immense wheat fields of California has been so cheapened by the use of automobiles, that a greater amount of the grain can be produced at a less actual cost than in Argentine Republic, where labor costs only a fraction of a dollar per day. The large traction engines used there are of 50 horse-power and are provided with driving wheels 60 inches in diameter. They do the plowing, planting and harvesting in their proper seasons. In the spring they track across the immense wheat fields 16 10-inch plows, four six-foot harrows, and a press drill for planting the seed wheat. One such traction engine, in this way, performs the triple work of plowing, harrowing and planting all in one operation.

INDUSTRIAL ITEMS

THE KEYSTONE ELECTRICAL INSTRUMENT COMPANY, Philadelphia, Pa., is shipping quantities of its specialties abroad, particularly to Great Britain, France, Spain, Japan and South America.

THE ELECTRIC APPLIANCE COMPANY, of Chicago, states that, although the summer months are ordinarily the dullest in the arc lamp business, it has sold more A. B. arc lamps that ever before.

THE SOUTH AFRICAN TRADING COMPANY, Copenhagen, Denmark, is in the market for the purpose of purchasing a large amount of machinery, a large part of which consists of engines and dynamos.

THE MORRIS ELECTRIC COMPANY, New York, N. Y., has just received a $20,000 contract for weather-proof cables, which are to be used by the Compania Limitado de Tranvias Electricos de Mexico, city of Mexico.

THE ECK DYNAMO AND MOTOR WORKS has removed its factory from Newark to Belleville, N. J., where all communications should be addressed hereafter. The new factory is located on Mill and Main streets.

JAMES L. ROBERTSON & SONS, of New York, Boston and Philadelphia, manufacturers of steam specialties, are presenting to their friends a new illustrated catalogue of their products. This firm makes a number of labor-saving devices, and its trade-mark, "Eureka," is known in every manufacturing centre.

MR. STEPHEN L. COLES, of the Shaughnessy Agency, New York, has produced another of his circulars calling attention to an "altruistic proposition" he is anxious to make to those who desire catalogues, bulletins or advertising matter prepared by one who knows how. It is quite effective and artistic.

THE WAGNER ELECTRIC MANUFACTURING COMPANY and the Bullock Electric Manufacturing Company sales department is issuing a most unique calendar for the month of August with more than ordinarily artistic effect, and on the back of which is an illustration of the Wagner single-phase motor.

MACHADO & ROLLER, 203 Broadway, New York, report a brisk demand for the new bond tester which they have lately offered to the trade. The bond tester is light, compact and accurate, and utilizes the current ordinarily flowing, giving joint resistances in terms of the resistance of a standard length of rail. It may also be used as a voltammeter.

THE CENTRAL ELECTRIC COMPANY, of Chicago, has recently become western sales agent for the Pittsburgh Transformer Company's products, and will send descriptive bulletins and quote prices to any one interested. The Pittsburgh company's type "K" transformer made for both high and low frequencies is well known by central station managers.

THE ROSSITER, MacGOVERN & COMPANY, 141 Broadway, New York, is sending out leaflets relating to electrical and steam machinery of first-class makers for railway lighting and power. A number of special bargains may be secured by writing this company at the present time. Extensive factories in Brooklyn, N. Y., and Jersey City, N. J., enable the company to supply the needs of its customers on very short notice.

THE WESTON ELECTRICAL INSTRUMENT COMPANY, through its New York selling agent, Mr. J. P. Brown, of 136 Liberty street, is sending to those who ask for it a very convenient "Pocket Price List" of the well-known Weston instruments. The little book embraces all standard portable and switchboard instruments made by the Weston company and will be found convenient by all who are interested in electrical measuring apparatus.

THE JOHN SCOTT PREMIUM and Gold Medal of the Franklin Institute, of Philadelphia, for what is considered the most noteworthy achievement in electrical science, has been awarded to the General Electric Company for its series alternating system of street arc lighting. During the two and one-half years the system has been before the public, 230 central stations have ordered 22,000 arc lamps for operation on this system, distributed in all parts of the world.

"KILFYRE" has had a new recruit in the person of Mr. Denis J. Swenie, for many years chief of the Chicago Fire Department. Chief Swenie has been made president of the Chicago Fire Appliance Company, which is the agency for the manufacturer of "Kilfyre." While he was fire chief in Chicago he had occasion to witness and approve the usefulness of "Kilfyre," and immediately upon his retirement took steps to identify himself permanently with the interests of the company.

THE SOUTHERN PACIFIC RAILWAY is sending out to the publishers of America a copy of its recently published "Prune Primer," an interesting little book describing the details of prune raising in California. This industry has assumed great proportions and is attracting wide attention. The booklet is known as the Southern Pacific Primer, Series No. 2, and will be forwarded on request sent to the passenger department of the Southern Pacific Company, San Francisco, Cal.

THE GENERAL INCANDESCENT ARC LIGHT COMPANY'S officers and employés participated in a pleasant and enjoyable outing at "Stimmels," Whitestone Landing, L. I., Saturday, July 27. A spirited and hotly contested game of baseball between the factory and office forces resulted in a tie, score 16 to 16. Bathing, bowling, wrestling and other sports occupied the time in ways that were more than pleasant, and after an enjoyable banquet all voted the day a jolly one and to be long remembered. The outing was held under the auspices of the "G. I." Club.

FIVE HUNDRED-KILOWATT GENERATORS DRIVEN BY GAS ENGINES—The Sprague Electric Company has recently closed an interesting order for three Lundell split-pole, 500-kilowatt, engine-type generators, with speed of 100 revolutions per minute, and wound for 250 volts, to be direct-connected to gas engines. These three generators of 500 kilowatts capacity each will be installed in the new works of the Lackawanna Iron and Steel Company, at Buffalo, and are designed for a continuous overload of 25 per cent at a high efficiency. The gas engines will utilize as fuel waste gas from the coke ovens of the Lackawanna company. These will probably be much the largest generators in this country ever operated by direct-connected gas engines, and the method of utilizing waste gases for such large amounts of power has never before been attempted in the United States. The Sprague Electric Company has been very successful with the split-pole machines, as the ingenious design, high efficiency and remarkable endurance give them high commercial value.

THE INDUSTRIAL DEPARTMENT OF THE LACKAWANNA RAILROAD, in charge of William B. Hunter, and having its headquarters at 26 Exchange place, New York city, has just issued a 300-page booklet under the caption, "Industrial Opportunities." This work treats of every town on the line, showing its population, its distance from New York and from Buffalo, its railroad facilities, its leading industries, its leading shipments, its rate of taxation, cost of labor, rent of houses, how lighted, whether it has waterworks, principal power, approximate cost of steam, coal, approximate value of lands, and describing vacant lands or factories available for manufacturing purposes. In the introduction the aim of the Lackawanna Railroad is set forth as follows: First, to give assistance to manufacturers in the selection of the most favorable site for their industrial enterprises; second, to help cities, towns and villages along the line to expand and broaden through the location of new industries. Advantages of this line in the mining regions of New Jersey and Pennsylvania and the agricultural districts in the State of New York are fully set forth. Copies of the book will be forwarded on application to the industrial department.

THE INTERCOLONIAL RAILWAY, of Canada, uses the 24-hour system of notation in which the hours are numbered from one to twenty-four, beginning at one o'clock in the morning. The advantage of this system consists in that it prevents mistakes from the position of a.m. and p.m. in reading timetables and in the operating of the railway generally. The Intercolonial road is under very enterprising management and extends from Montreal to Sydney, Cape Breton, a distance of about 1,000 miles. It is the through line between Montreal and Halifax and runs through some of the finest coal veins in the world. There is probably no more popular line in North America for the tourist and sportsman, as the Intercolonial, with the Prince Edward Island Railway, embraces 1,600 miles of thoroughly built road and with its rail and steamer connections in addition traverses some of the most varied and inviting tourist country on the continent. There is an increasing volume of travel year by year in the maritime provinces of Canada and this is catered to more and more by this system. Mr. E. G. Russell, a well-known railroad man of the United States, is now manager of the Intercolonial Railway, with headquarters at the city of Moncton, N. B. Mr. J. Wesley Allison, widely known in automobile circles, is the representative in the United States for the Intercolonial Railway.

THE MONARCH MANUFACTURING COMPANY, Waterbury, Ct., has recently received a contract from the Boston Elevated Railroad Company to equip the new engines at the Lincoln power station in Boston with the Monarch engine-stop system, and is now installing the apparatus. This system is also in use at the Albany street power station. The company has also received the third order from the United States Government for a system at the pumping station in Washington, D. C., where two systems have been in use for over eighteen months. Three systems were recently put in at the plant of Jones & Laughlin, Limited, Pittsburgh, also three systems at the Grand Crossing Track Company, Grand Crossing, Ill. The Illinois Steel Company, Chicago; Western Electric Company, Chicago; Republic Iron and Steel Company, Youngstown, Ohio; American Rubber Company, Chelsea, Mass.; American Steel and Wire Company, Cleveland, Ohio, and the American Cotton Oil Company, New Orleans, La., are among the recent installations of the Monarch system. This company has over three months' orders ahead on the Monarch system, which seems to be coming into general use. The company has recently increased its plant, doubling production, with the hope of meeting the increasing demands made upon it more promptly. It has a fine exhibition of the engine-stop system installed on a Fitchburg engine at the Pan-American Exposition, and invites any one interested to visit the exhibit when at the exposition. It has recently issued a very handsome little folder, illustrating the engine-stop and speed-limit, which it calls the Pan-American Flyer. The 1901 illustrated catalogue gives a very lucid and complete description of this system, which can be had by any one interested by addressing the Monarch Manufacturing Company, Waterbury, Ct.

List of Electrical Patents Issued Last Week

[Specially reported for this journal by E. S. Duvall, solicitor of patents, Loan and Trust Building, Washington, D. C. Copies of any patent may be secured for 10 cents each.]

ISSUED JULY 30, 1901.

679,304 Electric meter; W. C. Fish, Lynn, Mass.—Consists of motive devices normally tending to produce opposite directions of rotation, and means for varying the speed of the resulting rotation in response to variation of the quality to be measured by the meter.

679,308 Insulator; H. Geisenhoner, Schenectady, N. Y.

679,310 Signal system; J. L. Hall, Schenectady, N. Y.—A removable keyboard, separable contacts between the keyboard and the box containing it, and an independent set of connections with the signal-stand.

679,314 Electric railway; E. M. Hewlett, Schenectady, N. Y.

679,316 Electric-switch shell; H. Hubbell, Bridgeport, Ct.

679 321 Automatic switch; F. Mackintosh, Schenectady, N. Y.—A controlling magnet for a translating device, comprising a coil and retractile armature governed thereby, having a determinate retractile force, and an adjusting spring of weaker power opposing said retractile force.

679,331 Electric railway system; W. B. Potter, Schenectady, N. Y.

679,332 Surface contact railway; W. B. Potter, Schenectady, N. Y.—A feeder, a sectional conductor, a set of switches for a section of said conductor, which set comprises two or more switches, which are adapted to be operated simultaneously to connect the feeder and said section.

679,333 Electric meter; W. H. Pratt, Lynn, Mass.—A translating device and a relay governing its circuit connections, the relay armature being polarized by a conducting-stud adjacent to its magnet-core in circuit with the translating device.

679,357 Apparatus for treating metals by electrolysis; A. G. Betts, Upper Troy, N. Y.

679,362 Electric brake; F. E. Case, Schenectady, N. Y.—A controlling device provided with contacts for supplying current to the motors, contacts for supplying current to actuate the brakes, and contacts at one of the power points of the controlling device for sending a reverse current through the brake-shoe to demagnetize them.

679,405 Microtelephone; E. Volkers, Berlin, Germany—A telephone receiver, comprising an ordinary open box, an ordinary-sheet metal cover therefor, provided with peripheral turned-over portion or portions, snugly

(Continued on page 48.)

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PATENTS.

(Continued from page 47.)

fitting said box, and an electromagnet and securing means wholly within said box.

679,446 Automatic circuit-closer; G. A. Wall, Providence, R. I.

679,472 Multirate meter; F. P. Cox, Lynn, Mass.—Comprises two dial-trains, a meter-motor, means for periodically and alternately connecting a clutch with the several dial-trains, either dial train being locked against rotation when disconnected from the clutch.

679,476 Electrolyzing apparatus; J. F. Kelly, Pittsfield, Mass.

679,477 Electrolytic decomposing-cell; J. W. Kynaston, Liverpool, England.

679,518 Electrical stop for engines; J. F. Skirrow, East Orange, N. J.—A controlling mechanism, an electric motor connected thereto, a main motor-circuit, means for closing said motor-circuit, a closed safety-circuit, means in said safety-circuit operating normally to hold open the motor-circuit-closing means, and to release said closing means when the current through the safety-circuit is interrupted.

679,544 Insulator for electric wires; J. E. Sharpe, Oneida, N. Y.

679,546 Secondary electric clock; T. H. Wurmb, St. Louis, Mo.

679,615 Underground electric conductor for street railways; J. Floyd, Philadelphia, Pa.—A cut-out having the negative and positive conductor-rails arranged upon one side of the conduit.

679,651 Electrical ignition apparatus; A. E. Vorreiter, Aix-la-Chappelle, Germany—An igniter consisting of a casing of magnetizable material, a stationary induction-coil within said casing, and stationary, permanently separated igniter-points connected with said coil.

679,654 Burglar alarm; W. J. Wernette, Remus, Mich.

679,683 Time-operating mechanism; C. H. Mayers, Washington, D. C.

679,700 Electric arc lamp; S. M. Meyer, Brooklyn, N. Y.—Consists of a pair of electrodes operatively connected to each other, a solenoid and a rigid solenoid-core cooperating with the said solenoid and operating to effect the feed of the electrodes, the said solenoid-core comprising in its structure a series of turns of wire of flexible magnetic material.

REISSUE.

11,924 Electric hose-signal system; Howard Sargent, Boston, Mass.

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